S. Hrg. 99-345

NATIONAL SCIENCE FOUNDATION AUTHORIZATION ACT FOR FISCAL YEAR 1986

HEARING

BEFORE THE

COMMITTEE ON LABOR AND HUMAN RESOURCES UNITED STATES SENATE

NINETY-NINTH CONGRESS

FIRST SESSION

ON

S. 801

TO AUTHORIZE APPROPRIATIONS FOR THE NATIONAL SCIENCE
FOUNDATION FOR FISCAL YEAR 1986

APRIL 30, 1985

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CONTENTS

STATEMENTS

Tuesday, April 30, 1985

Page
Acker, Dr. Robert F., chairman, Public Responsibilities Committee, American Institute of Biological Sciences, prepared statement 167
American Society for Engineering Education, prepared statement 190
Bloch, Erich, Director, National Science Foundation, and Dr. Roland W. Schmitt, Chairman, National Science Board 11
  Prepared statement of Mr. Bloch 34
  Prepared statement of Mr. Schmitt 22
Consortium of Social Science Associations, prepared statement 200
Crowley, John C., director of Federal relations for science research, Association of American Universities, prepared statement 177
Dodd, Hon. Christopher J., a U.S. Senator from the State of Connecticut, prepared statement 9
Fields, Dr. Ellis K., president, American Chemical Society, prepared statement 144
Halvorson, Drs. Harlyn O., and Monica Riley, Public and Scientific Affairs Board, American Society for Microbiology, prepared statement 174
Hamburg, Dr. David A., president, American Association for the Advancement of Science, prepared statement 86
Krauss, Robert W., executive director, Federation of American Societies for Experimental Biology, prepared statement 210
Pallak, Dr. Michael S., executive officer, American Psychological Association, prepared statement 135
Quayle, Hon. Dan, a U.S. Senator from the State of Indiana, prepared statement 4
Steen, Dr. Lynn Arthur, president, Mathematical Association of America, prepared statement 160
Thurmond, Hon. Strom, a U.S. Senator from the State of South Carolina, prepared statement 7
Weinert, Donald G. P.E., executive director, National Society of Professional Engineers, prepared statement 153

ADDITIONAL MATERIAL

Articles, publications, etc.:

  Report of the NSB Committee on Excellence in Science and Engineering .. 13
  NSF Support for the Academic Research Fleet 75

Questions and answers:

  Responses of Mr. Bloch to questions submitted by Senator Kennedy 66

NATIONAL SCIENCE FOUNDATION AUTHORIZATION ACT FOR FISCAL YEAR 1986

TUESDAY, APRIL 30, 1985

U.S. SENATE,
COMMITTEE ON LABOR AND HUMAN RESOURCES,
Washington, DC.

The committee met, pursuant to notice, at 9:34 a.m., in room SD-430, Dirksen Senate Office Building, Senator Orrin Hatch (chairman) presiding.

Present: Senators Hatch, Nickles, Grassley, Kennedy, and Pell.

OPENING STATEMENT OF SENATOR HATCH

The CHAIRMAN. We are happy to welcome everybody here this morning. We are here to examine the National Science Foundation and review its request for funding in fiscal year 1986.

We will hear testimony from Mr. Erich Bloch, Director of the NSF since last summer. He is accompanied by Dr. Roland Schmitt, Chairman of the National Science Board and senior vice president of the General Electric Co.

The National Science Foundation, as our Nation's flagship science agency, emphasizes fundamental basic research in all scientific and engineering disciplines. Without basic research as the first step, we could not take the second and third steps toward developments such as the space shuttle or the artificial heart. We can only guess at the advances which will be made in the next 15 years, leading up to the 21st century, and therein lies the importance, as I see it, of NSF and the research and education programs it supports.

The bill we will discuss this morning, S. 801, represents the Reagan administration's proposal for funding the NSF for the next fiscal year. The very fact that the administration has recommended a 4-percent increase for the Foundation in a year of budgetary austerity is indicative of the belief that scientific and technological investment is necessary for our Nation's future.

The bill also contains recommendations for amendments to the NSF Organic Act of 1950 to formally recognize the role of engineering in the scientific enterprise.

At this point we will receive for the record the opening statements of Senators Kennedy and Grassley, and the prepared statements of Senators Quayle, Thurmond, and Dodd.

[The statements follow:]

OPENING STATEMENT OF SENATOR KENNEDY

Senator **Kennedy**. I would like to thank the chairman for holding these hearings on the reauthorization of the National Science Foundation. I would also like to thank Mr. Bloch and Mr. Schmitt for attending these hearings.

Science is bipartisan. It has no philosophical bent. This bipartisanship is reflected in the administration's budget proposal in this legislation and in the legislation that was recently passed in the House of Representatives.

The administration proposed to increase the budget of NSF by about 4 percent. I am fully supportive of this increase. Budget realities are forcing us to make some hard decisions in Federal spending priorities. However, there is no greater priority than the continued support for basic research in science and engineering.

Today's investment in basic research will be tomorrow's savings in terms of technological edge and economic competitiveness.

This fact is reflected in the Foundation's funding priorities which include more support for basic research directly related to economic competitiveness. Along these lines, I understand the Foundation is moving rapidly to implement the supercomputer initiative. Also I understand that engineering centers are being established with great efficiency. I commend Mr. Bloch for these efforts and am interested in hearing more on these subjects.

I am also interested in hearing about the progress of the Science Education Program. I understand that the Foundation is proposing a $32 million deferral of funds in this area. This is hard to understand in light of the critical need for math and science teachers in our schools and colleges.

I understand that the Evist Program was eliminated in the budget. This program serves an important function by providing for research on ethical implications of our science and technology developments. What, for instance, are the ethical implications of the developments in biotechnology? Are we approaching a "brave new world"? I am interested in hearing from Mr. Bloch on this.

I have a number of other questions. However, let me say at this point, that the work of Mr. Bloch at the Foundation up to now has been commendable.

OPENING STATEMENT OF SENATOR GRASSLEY

Senator **Grassley**. Mr. Chairman, I am pleased to have the opportunity this morning to hear from Mr. Bloch, the distinguished Director of the National Science Foundation, on authorized funding for its activities during fiscal year 1986. There is no doubt that the National Science Foundation over the years has provided vital support for engineering and science education and research in our Nation. In fact, it can take credit for helping this Nation achieve international prominence for our many scientific accomplishments and prize-winning research.

Yet, many feel that we must not rest on past laurels and that much needs to be done to maintain our world standing in science and engineering by improving the quality of our scientific instruction. Our scientific strength and technological capability depend directly on the quality of the scientific education received by our students. Declining competence of our students in science, engineering, and mathematics has received much public attention in the past several years. Poorly trained high school students have translated into lowered standard test scores in science and math, and threaten to result in a poorly prepared and uncompetitive work force.

The quality of math and science instruction has declined in part because of a shortage of qualified teachers in these subjects. Not only are a high percentage of our science and math teachers unqualified to teach math and science, but many are employed on an emergency basis because no legitimately qualified teachers can be found. Over 43 States have reported a shortage of math and science teachers according to a study by the National Science Teachers Association. According to a study by the National Science Foundation, most elementary teachers lack confidence in their knowledge about science and scientific concepts, and lack time and materials to develop a meaningful science program. Not only do teachers lack the proper training and educational background to be effective instructors in these disciplines, but many potential teachers are lured away from the teaching profession by higher salaries in the private sector.

This committee has responded to this national concern over the quality of science and engineering education by formulating legislation which was enacted into law on August 11 last year. Public Law 98-377 gave the National Science Foundation a major role in improving scientific education by providing authorization for summer teacher institutes, development of instructional materials, teaching awards, congressional merit scholarships, and partnership activities between educational institutions and the private sector. Unfortunately, the math/science bill was not approved by the Congress until after it made appropriations for fiscal year 1985, and therefore some of the programs have been left unfunded. I look forward to discussing with Mr. Bloch those aspects of the bill which are being carried out by the National Science Foundation.

In a more general sense, I note with interest that the administration has recommended a 4-percent increase in funding this year for the Foundation. In the past several years, the Congress has responded to requests for substantial increases in appropriations for National Science Foundation education and research activities, and I look forward to a discussion on accomplishments as a result of that increased support.

[The prepared statements of Senators Quayle, Thurmond, and Dodd follow:]

STATEMENT OF SEN. DAN QUAYLE AT LABOR AND HUMAN RESOURCES COMMITTEE HEARING ON THE REAUTHORIZATION OF THE NATIONAL SCIENCE FOUNDATION

April 30, 1985

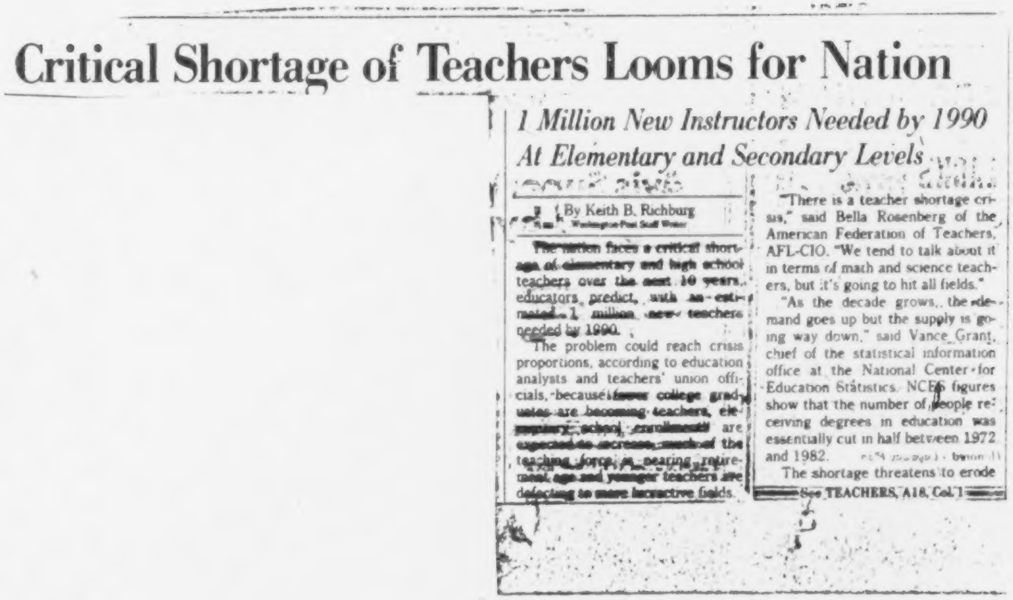
Mr. Chairman, I am very happy that you are holding this hearing today on the reauthorization of the National Science Foundation (NSF). The National Science Foundation plays a key role in helping colleges and universities and research groups to fund basic scientific and engineering research. With a budget of $1.5 billion, the NSF reaches more than 2000 institutions, funds international science programs and funds science and engineering education for secondary and postsecondary students. The NSF has maintained consistently high quality programs and its peer review system to determine grantees is widely respected throughout the scientific and academic communities.

I am particularly interested in the science and engineering directorate at the NSF and their plans for implementing provisions of the Education For Economic Security Act, P.L. 98-377. This law, signed by the President last year, mandates the provision of several programs to foster the teaching of math and science education, and to establish Partnerships in Education between the private sector, schools, and the state, using resources from all three, to offer unique ways of teaching math and science and engineering education.

Additionally, I am especially concerned about the loss of control that this authorizing committee has experienced in dealing with the NSF. Over the last four years, the appropriations committees have been directing the expenditure of funds and overseeing the activities of the Foundation in place of this Committee. Because of a jurisdictional dispute, we have effectively lost our control of the Foundation to the appropriations committee. I am hopeful that this year we can solve this jurisdicational dispute so that we can give the NSF more attention and better direction.

Returning to Public Law 98-377, let me say how disappointed I am that the NSF has failed to develop programs to implement the Partnerships in Education program. I am equally disappointed that the Administration has failed to request and the NSF will not be seeking reauthorization of Titles I and III of the Math and Science bill. These programs were supported unamimously by both Houses of Congress and are needed to help address the lack of math and science teachers and to improve science and math education. Just this morning on the front page of the Washington Post, was an article, "Critical Shortage of Teachers Looms for Nation". The article discussed the increase in student enrollment due to the baby boomlet and the need for more teachers. It appears we will be experiencing shortages in many fields, but we still have not yet caught up from the shortages in math and science from the last few years. This new shortage will make it even worse.

I am hopeful that the Congress will decide quickly on the reauthorization of the math and science bill so that the NSF will be able to implement the programs under it. I look forward to working with you on this and appreciate your being here today.



Critical Shortage of Teachers Looms for Nation

1 Million New Instructors Needed by 1990 At Elementary and Secondary Levels

By Keith B. Richburg
Washington Post Staff Writer

The nation faces a critical shortage of elementary and high school teachers over the next 10 years, educators predict, with an estimated 1 million new teachers needed by 1990.

The problem could reach crisis proportions, according to education analysts and teachers' union officials, because fewer college graduates are becoming teachers, elementary school enrollments are expected to increase, much of the teaching force is nearing retirement age and younger teachers are defecting to more lucrative fields.

"There is a teacher shortage crisis," said Bella Rosenberg of the American Federation of Teachers, AFL-CIO. "We tend to talk about it in terms of math and science teachers, but it's going to hit all fields."

"As the decade grows, the demand goes up but the supply is going way down," said Vance Grant, chief of the statistical information office at the National Center for Education Statistics. NCES figures show that the number of people receiving degrees in education was essentially cut in half between 1972 and 1982.

The shortage threatens to erode

See TEACHERS, A18, Col. 1

Experts Blame Shortage of Teachers On Labor Market, Demographics

TEACHERS, From A1

recent educational reforms while posing a painful dilemma for state legislatures. Pressed for the need to recruit more teachers, state politicians also must meet the competing public demand to raise teaching standards as a way to improve student performance.

Some school districts have begun hiring classroom instructors without traditional teaching qualifications. The Los Angeles Unified School District, for example, hired 167 "teacher-trainees"—college graduates with no teacher training—to meet their need for instructors last fall.

Education experts blame the impending crisis on a combination of demographic factors and changes in the labor market over the last two decades. A small "baby boomlet" of children born in the 1970s is entering the classrooms, and teachers of the post-World War II generation—many of whom went to college on the G.I. bill—are in their fifties and nearing retirement.

Increased job opportunities for women and blacks have deprived the teaching field of its most dependable pool of recruits.

"There was a time when women and minorities, if they wanted to enter a profession, had to go into teaching," Rosenberg said.

The teaching field is also plagued by massive defections by younger instructors, according to studies by the Rand Corp. and the American Enterprise Institute.

By most estimates, up to half of new teachers leave the job within five to seven years, usually expressing dissatisfaction. Even more discouraging to educators is the exodus of the most qualified teachers, those with the best test scores and school performance.

The pending crisis, coupled with the push for reform, has forced many states to pursue often contradictory policies, known in the education field as "screens and magnets."

"Screens" are policies aimed at "screening out" poor teachers. These include teacher-competency tests; stiffer professional requirements, such as prescribing certain college courses, and efforts to raise entrance and exit requirements at schools of education. Last year, 30 states had some form of teacher-competency test and a dozen more were considering them.

"Magnets" are policies to attract people to teaching: They include pay raises, forgivable loans and scholarships for students who want to study teaching, and proposals to use untrained college graduates to meet teacher shortages. Florida and New Jersey use these "alternative" teacher-certification plans. Some 28 states offer loans and scholarships.

"State policies are gradually changing from screens to magnets," said Stanford University Prof. Michael Kirst, former president of the California State Board of Education. "States are throwing out all sorts of magnets to see which ones work. It's like throwing out a fishing line to see what comes up."

"California is trying them all," he said. "We can't afford them all."

California—like most Sun Belt states with growing populations—will be among the first to feel the crunch, experts say. State education officials project that, with the growth of the immigrant population and migration from other states, school enrollment will expand by 600,000 by 1990.

At the same time, California officials see a need for 110,000 new teachers by 1990—in a total teacher population of just 170,000. In other words, the state will have to replace approximately two-thirds of its teacher force in the next five years. "It's a massive need for us," said Bill Honig, California superintendent for public instruction.

California's teacher population is aging rapidly. The state's teachers are five years older than the national average of 40, Honig and Kirst said. In Palo Alto, the average teacher is 50. San Francisco recently found that it had not hired a single new teacher who graduated from an education school after 1964.

The state has addressed the problem in several ways. Local school boards can declare an emergency because of the shortage, then hire any college graduate to teach as a special trainee—as happened last fall in Los Angeles. Some cities, like Modesto in rural Stanislaus County, have even gone on the road to scout for talent.

"We see more and more localities going out recruiting," Honig said. "And they're going out East, is where they're going."

While state capitols have grappled with the problem through a variety of initiatives, the federal government has been less active. Congress last year, however, did approve a Talented Teacher Act, giving $96 million in scholarship aid to students of education, and separate programs to upgrade the teaching of math, science and "critical" foreign languages.

Educators said the "great unknown" in the teacher crisis is the "reserve army," the thousands of people with teacher training who have left the profession—many of them women who left after marriage.

"Will they come back?" Kirst asked. "If so, under what conditions? There are just a lot of people out there who, on paper, are qualified to teach."

STATEMENT BY SENATOR STROM THURMOND (R-S.C.) BEFORE THE SENATE COMMITTEE ON LABOR AND HUMAN RESOURCES REFERENCE S. 801, THE NATIONAL SCIENCE FOUNDATION REAUTHORIZATION BILL, SD-430, APRIL 30, 1985. 9:30 A.M.

MR. CHAIRMAN:

It is indeed a pleasure today to receive testimony on S.801, the Reauthorization Bill for the National Science Foundation. The Foundation has sponsored many worthwhile research programs since its creation in 1950. However, prior to 1980 some of us who are here today, including you, Mr. Chairman, and myself, voiced our dissatisfaction over the inequitable distribution of National Science Foundation (NSF) research grant funds to only a handful of States. In response to this problem, the Experimental Program to Stimulate Competitive Research, or "EPSCOR", was created. I am proud to state that EPSCOR has been one of the most successful NSF endeavors.

South Carolina was chosen as one of the first five states in the initial EPSCOR five year program. Prior to EPSCOR, scientists from Clemson University and the University of South Carolina, and other similarly situated institutions, could not adequately compete with the larger colleges and universities for Federal research and development funds. Because of EPSCOR, the commitment of the State, and the research institutions in the State, we have enjoyed the most dramatic increase of all States in receiving federal research and development monies. South Carolina is now ranked 28th in the Country in total NSF funds received. Prior to EPSCOR, South Carolina was 46th in the Country. The FY 86 budget request for NSF would continue EPSCOR and would allow other States to benefit as South Carolina has in the past.

Of particular significance in this Reauthorization Bill are the amendments which would reform the mission of the Foundation to include the support of engineering research as a critical component of the overall mission of the Foundation. Considering the current international trade situation and our serious trade deficit with countries such as Japan, there has never been a more important time to develop new technologies. These amendments recognize the crucial role of engineering research to our Nation's future.

In the Earth Sciences area, the Continental Lithosphere program will provide us with a better understanding of the earth and will provide necessary information which would assist in predicting earthquakes and in discovering oil reserves. This NSF program may provide great commercial benefits to our Country. The University of South Carolina is one of five research institutions involved in this worthwhile project and is the lead institution in the site selection process.

I am pleased that the Administration, by this Reauthorization bill, recognizes the continuing need for our Country to make technological and scientific advances, and I look forward to reviewing the testimony to be presented today.

STATEMENT OF SENATOR CHRISTOPHER J. DODD
FOR THE FULL LABOR COMMITTEE HEARING ON
NATIONAL SCIENCE FOUNDATION AUTHORIZATION
APRIL 30, 1985

I WANT TO TAKE A MOMENT TO COMPLIMENT THE NATIONAL SCIENCE FOUNDATION ON THE VERY FINE JOB IT HAS DONE IN SUCCESSFULLY CARRYING OUT THE ORIGINAL CONGRESSIONAL MANDATE TO PROMOTE SCIENCE EDUCATION AND RESEARCH.

SCIENTIFIC RESEARCH AND TECHNOLOGICAL DEVELOPMENT ARE COMING TO BE SEEN AS HAVING AN INCREASINGLY IMPORTANT ROLE IN MEETING NATIONAL NEEDS. PROGRAMS FOR ECONOMIC RECOVERY, EMPLOYMENT, HEALTH, EDUCATION, ENVIRONMENT AND FOREIGN TRADE AND NATIONAL SECURITY ALL CONTAIN MAJOR ELEMENTS DEPENDENT OR PREDICATED ON VIGOROUS GROWTH OF BASIC RESEARCH AND THE APPLICATION OF NEW KNOWLEDGE FOR TECHNOLOGICAL DEVELOPMENT.

AT THE SAME TIME, THE NEED TO ENSURE THE NECESSARY NUMBERS OF EDUCATED AND COMPETENT TECHNICIANS, ENGINEERS, RESEARCHERS AND EDUCATORS IS BECOMING EVEN MORE CRUCIAL TO THE CONTINUED VIABILITY OF THESE IMPORTANT NATIONAL PROGRAMS.

BUT THE U.S. IS NOT ALONE IN REALIZING THE IMPORTANCE OF BASIC AND APPLIED RESEARCH AND THE COMMERCIALIZATION AND THE MILITARY APPLICATION OF RESEARCH PRODUCTS.

OTHER DEVELOPING AND INDUSTRALIZED COUNTRIES ARE PUTTING MORE EMPHASIS ON AND ALLOCATING MORE FINANCIAL RESOURCES FOR EDUCATION, RESEARCH AND TECHNOLOGICAL DEVELOPMENTS. THE UNITED STATES, IN ORDER TO MAINTAIN CURRENT TECHNOLOGICAL AND SCIENTIFIC SUPREMACY, CANNOT AND MUST NOT TAKE A BACK SEAT TO ANY OTHER NATION IN SAFEGUARDING OUR PRESENT SCIENTIFIC EDUCATION AND RESEARCH BASE.

I WOULD QUESTION, HOWEVER, THE PRESENT BUDGET REQUEST OF $1,569.4 MILLION -- A 4.4 PERCENT INCREASE OF $66.7 MILLION ABOVE THE FY85 LEVEL OF $1,502.7 MILLION.

I QUESTION THIS INCREASE IN LIGHT OF THE FACT THAT NSF RECEIVED AN INCREASE OF ABOUT 15% IN THE CURRENT FISCAL YEAR.

LET ME REITERATE MY SUPPORT FOR SCIENCE EDUCATION AND RESEARCH. I QUESTION THE ADMINISTRATION'S PROPOSED INCREASE, HOWEVER, ONLY BECAUSE AT THE SAME TIME, IT HAS AGREED TO A REDUCTION IN SUPPORT FOR OTHER IMPORTANT EFFORTS.

THE BEST WE CAN BE LOOKING AT IN THIS AREA IS A FREEZE IN THE CURRENT YEAR'S LEVEL, AND QUITE FRANKLY, WE MAY HAVE TO GO A LITTLE BIT FURTHER. THIS MORNING'S HEARING SHOULD PROVIDE US WITH A BASIS TO UNDERSTAND WHAT SUCH A FREEZE WOULD MEAN IN TERMS OF THE ACTIVITIES OF THE NSF.

The **Chairman**. I have been pleased to work with three previous NSF Directors—two since I have been chairman of Labor and Human Resources. So it is a pleasure to welcome you, Mr. Bloch, to the committee for the first time. I look forward to working with you and your staff on the science and education issues which are of mutual concern.

We are happy to have you with us, and also Dr. Schmitt.

We will just turn the panel over to you.

STATEMENT OF ERICH BLOCH, DIRECTOR, NATIONAL SCIENCE FOUNDATION, AND DR. ROLAND W. SCHMITT, CHAIRMAN, NATIONAL SCIENCE BOARD

Mr. **Bloch**. Thank you, Mr. Chairman. I appreciate being here this morning to discuss the NSF budget with you.

Let me first, however, introduce Dr. Roland Schmitt, Chairman of the National Science Board, and the vice president of R&D for the GE Co., who would like to make a few comments.

Dr. **Schmitt**. Thank you, Erich and Mr. Chairman.

It is a pleasure for me to be here today. As has been stated, I am Roland Schmitt, senior vice president of corporate R&D for General Electric and Chairman of the National Science Board, and it is in the latter capacity that I am testifying here today.

You have a copy of my testimony. I am going to abbreviate it somewhat in my formal presentation here.

The **Chairman**. Thank you.

Dr. **Schmitt**. It is my pleasure to join Erich Bloch in appearing before you to discuss this authorization of the fiscal 1986 budget for the National Science Foundation.

As you stated, today the Nation faces heightened international competitive challenges: economic, military, and technological. This competition truly broadens the demands on science and engineering research and education, and these pressures make it more important than ever before to strengthen the science and engineering base that underlies all our technology efforts.

The Federal Government plays the leading role in supporting universities in their efforts to do research and provide personnel for the future. So, even in this time of necessarily constrained budgets and hard choices among many worthwhile goals, the President's fiscal year 1986 budget attaches priority to the continuing need for strengthening the academic science and engineering base on which the Nation's economic and military security depend.

This need is being met by several recent initiatives that provide new environments and capabilities for strengthening research and education. The National Science Foundation has begun the process of creating engineering research centers, which is a new form of university-industry cooperative research effort that puts cross-disciplinary teams of engineering faculty and undergraduate and graduate students to work on problems that combine both intellectual excitement with economic value.

Another such initiative is the plan to establish advanced scientific computing centers, to enhance progress in many areas of science and engineering research and education. The computing revolution has created dramatic improvements in all aspects of doing science and technology. Strengthening the science and engineering base requires making sure that the next generation of scientists and engineers can also use these tools.

Universities also continue to experience severe problems in obtaining state-of-the-art research instrumentation. In response to that, the NSF is continuing to increase support for instrumentation on all levels, from individual projects and investigators to national centers serving hundreds of scientists and engineers.

Another major initiative, the Presidential Young Investigators Program, addresses the problem of faculty shortages. Universities need outstanding scientists and engineers in teaching positions if they hope to turn out outstanding graduates in science and engineering. But retaining those teachers is difficult, and the Presidential Young Investigators Program provides a big incentive for staying in teaching.

Science and engineering education also needs strengthening, particularly at the pre-college levels. The NSF is responding with new efforts to strengthening the science and engineering education programs, as Erich Bloch will describe to you in just a moment.

Finally, the past decade has witnessed a phenomenal expansion in biological science and technology. In response to this, the NSF is undertaking an initiative that will support biotechnology-related research underlying such goals as the improved growth and utilization of food and fiber crops, better medicines and diagnostic techniques, and improved production of specialty chemicals.

These are some of the initiatives meeting what I regard as NSF's top priority—strengthening the Nation's science and engineering base.

I would also like to note that the National Science Board recently approved a report and statement on the issue of educational institutions attempting to bypass merit-based review through the legislative process. The Board made three recommendations in that respect, which you have in the written version of the testimony. With your permission, I would like to submit a copy of the Board's entire statement for the record.

The CHAIRMAN. Without objection, we will place it in the record at this point.

[The statement referred to follows:]

NSB-85-50
February 22, 1985

REPORT OF THE NSB COMMITTEE ON EXCELLENCE IN SCIENCE AND ENGINEERING

Charge to the Committee

On September 27, 1984, the Chairman of the National Science Board established an ad hoc Committee on Excellence in Science and Engineering. He charged this Committee to recommend the proper role and policy for the National Science Foundation in addressing the issue of educational institutions attempting to bypass merit-based review through the legislative process. The Committee was also asked to address the underlying factors that have given rise to this situation and examine alternative solutions to them.

Our report begins with a presentation of the magnitude of the merit review bypass activities used to obtain funds for major facilities at educational institutions and the implications of this practice for the future of excellence in science and engineering in the United States. Next, the underlying factors are discussed, followed by our recommendations to reaffirm merit-based review and identify options for facilities support.

Magnitude of the Problem

A growing number of educational institutions have attempted to secure funding for facilities by bypassing the merit-based review system and appealing directly to Congress.

In the past two years, fifteen universities have obtained direct Congressional authorization or appropriation for academic projects valued at over $100 million (see summary listing in appendix B, Table III). These projects, which are described in Table II, relate to scientific and engineering facilities and research. In some cases, universities have hired professional lobbyists, and many have exerted pressure on their representatives.

The Committee believes that these actions establish a dangerous precedent. Because of the need for new and renovated facilities, university administrators will be pressured by their faculties and others to follow the example of the major universities that have successfully secured funding for facilities by appealing directly to Congress. If this becomes common practice, it could seriously undermine the U.S. system of merit competition for research funding that has been so successful during the recent period of U.S. scientific dominance.

Implications of Special Interest Funding for Scientific Research

The direct appeal to Congress by educational institutions for funding scientific facilities undermines the peer review process, which has proved to be the most reliable guarantor of excellence in scientific funding decisions, diverts scarce research and education dollars to projects of questionable scientific merit, and seriously affects the direction and priorities of scientific research. This could well threaten the integrity of the U.S. scientific enterprise that is the basis of the scientific, technical, and economic competitive position of the U.S. in the world.

Equally important, widespread circumvention of the merit review process will erode the basis of the system of federal support for basic research. That system has rested on a delicate balance between federal funding of research and federal control of research and has trusted the scientific community to determine the nature of that research and ensure its excellence. Increased resort by the scientific community to direct political measures would destroy the perception of its objectivity and integrity, erode the trust with which it has been vested, imperil its autonomy, and forfeit its right to play a significant role in federal resource decision-making.

In the near term, the recent activities also raise apprehensions regarding the potential impact on new research programs, such as the NSF's supercomputer program and engineering research centers and the possibility that facilities funded by direct Congressional action will later induce Congress to further action and allocate funds for programmatic research to the selfsame institutions without merit review.

Underlying factors

The Committee on Excellence has concluded that the present spurt of direct appeals for Congressional action on academic projects is symptomatic of an underlying need in many U.S. academic institutions for facilities support. This need is not adequately addressed by present funding mechanisms in either the public or the private sector. Thus, opportunistic solutions, i.e., political action, become compelling.

Congressional responses to constituent pressures are an established part of the decision-making process in such public works projects as highways, mass transit, dams, harbor and river activities. Academic and research programs have received some such special-interest funding, particularly for applied research, from agencies where peer review is not the dominant method for making decisions on grants. Funding decisions made by state governments and legislatures have also often been subject to local constituency pressures.

In contrast, scientific funding at the federal level, particularly for basic research, has enjoyed considerable freedom from special interest politics, and has been allocated on the basis of merit. Since the federal government, after the second world war, assumed a major role in the funding of basic scientific research at universities, science has enjoyed considerable autonomy in planning and supporting research. But, even with respect to basic scientific research, considerations other than scientific excellence, such as geographic distribution and equal opportunity, have been a consistent part of the decision-making process. In fact, the NSF criteria for merit review make allowance for these considerations, but always coupled and in conjunction with scientific merit determination. The significance of the incidents since FY 1983 is that such considerations have superseded, rather than supplemented, merit based review. This threatens the integrity of what has been an effective and successful system for funding the highest quality research in science and engineering at universities.

The current magnitude of this threat reflects an underlying need. While no recent comprehensive survey of facilities requirements for educational institutions has been conducted, available evidence indicates a serious need for facilities. Hearings on "Improving the Research Infrastructure at U.S. Universities and Colleges," held before the House Committee on Science and Technology on May 8, 1984, provided an indication of this need, as did the deliberations of the National Science Board at its June 1984 meeting addressing "Academic Science and Engineering: Physical Infrastructure." (Appendix C) Federal support for university facilities, significant during the 1960's, all but ceased by the early seventies. In many universities, the need for facilities to house new research initiatives combines with the deterioration and obsolescence of existing structures to put considerable pressure on scarce resources that are inadequately supplemented by state and private funding. This pressure may also have been accentuated by increased funding for science and engineering research without a balanced consideration of the resulting demand on inadequate facilities. In addition, the cost of facilities and equipment has increased more rapidly than that of human resources. The maintenance, renovation, and acquisition of research facilities have become primary concerns for many educational institutions.

Recommendations

There are three primary recommendations. They address: the reinforcement of merit review, the possible solutions to the facilities problem, and the continuous review and improvement of the merit review system at NSF.

A. Reinforcement of Merit Review:

Self-regulation has been an essential component of the success of the post-war scientific and engineering research enterprise. The continued commitment by universities and the research community to self-regulation is essential to its health and vitality.

Recommendation 1: Directly, indirectly through scientific societies and summit organizations, and jointly with such organizations, the Director and members of the National Science Board should continue to speak out on the self-defeating consequences of circumventing the merit review system. Specific actions should include communication with university representatives, scientific advisory groups, Members of Congress, and coordinating and planning boards of state governments.

B. Review of NSF Merit Evaluation Processes:

Merit review, which is central to decisions on grants at NSF and several other agencies, is recognized as a key factor in assuring the quality of U.S. academic research and is being emulated by other countries. The current need to reassert the importance of the merit review system with respect to funding research facilities underscores the need for such continuing scrutiny and improvement. In particular, we need to:

1. Analyze how comprehensive merit review applies to diverse activities, such as general research grants, instrumentation awards, facilities and special programs (e.g. international, women and minority programs);

2. Understand and analyze the differences between the implementation of comprehensive merit review among various NSF directorates and federal agencies.

Recommendation 2: The Director should appoint a committee to review evaluation processes within NSF, review other agencies' approaches and recommend any modifications that it judges desirable.

C. Characterizing and Attacking the Facilities Problem:

Attacking the facilities problem will require the concerted efforts of universities, states, the Federal Government, and the private sector. The National Science Board, working with other organizations such as the Office of Science and Technology Policy, the White House Science Council, the National Academies of Sciences and Engineering, the Research Roundtable, and the National Research Council, should provide leadership in (1) characterizing the nature of the problem, and (2) developing politically feasible solutions.

1. Characterizing the Problem: The "facilities problem" is in part a need for renovation of existing facilities, in part a need for upgrading existing facilities, and in part a need for new facilities. The National Science Board discussion in June 1984 of academic infrastructure needs in science and engineering has laid the basis for understanding the problem and has resulted in an NSF pilot program for the renovation and reconstruction of research related facilities in select fields. However, important questions remain to be answered. Are some aspects of the problem more pressing than others? Or does the nature of the problem vary with institution?

2. Developing Feasible Solutions: The potential solutions must be considered from two viewpoints: near-term quick fixes and more long-range total solutions. The most commonly discussed options are competitive

grants, adjustment of the indirect cost reimbursements to universities, and changes in the tax code to permit universities to issue tax-exempt bonds to finance facilities. What are their advantages and disadvantages?

These options assume that the Federal Government will play the major role in attacking the facilities problem. But given current fiscal constraints, state governments and universities themselves will also have to play prominent, if not lead, roles. What should be the nature of those roles? Are "creative financing" options available to universities and states regardless of whether or not the Federal Government plays a major role?

Recommendation 3: To address these issues and to launch actions to solve them, the National Science Board, the National Academies, and the Office of Science and Technology Policy should call for a conference among the interested parties to be held as soon as possible. The Conference on Academic Research Facilities should draw on the NSB study on academic research infrastructure and on talent from the financial community, Congress, state governments, federal agencies, academic institutions and business to define the problem and propose politically feasible solutions.

NSB Statement on Bypassing Merit Review in the Funding of Academic Research Facilities

Recent efforts by educational institutions to secure funding by appealing directly to Congress and bypassing the merit based review system represent the wrong solution to a real and urgent problem. The problem of deteriorating university research facilities threatens the health of the Nation's science and engineering base. To generate better solutions, the parties involved should meet to plan new initiatives that support university research without threatening the established science and engineering priority setting process that has served so well to promote excellence.

In the past two years, fifteen universities have bypassed that process and secured over $100 million for construction of facilities by appealing directly to Congress. In a number of cases, the funds were diverted from other scientific activities that had been selected on the basis of their merit.

The National Science Board has examined the implications of this development for the excellence and productivity of U.S. science and engineering, which today is the strongest in the world. As the challenge to America's competitiveness in defense and industry grows, so too does the Nation's reliance on its science and engineering strength. Bypassing the normal standards of scientific excellence through merit review procedures in science and engineering research jeopardizes this strength.

The problem is not yet severe, but the precedent has been established; lobbyists sense a source of funds, and each new circumvention increases pressure on schools that have so far resisted the temptation to pursue the same course. The question facing American universities today is this: Will they retain responsibility for the excellence of U.S. science and engineering, or will they cede it to purely political processes. The choice is in the hands of the science and engineering community. The trend is in the wrong direction.

The circumventions of merit review are being triggered by a serious problem: At many universities, facilities are deteriorating. Until this problem is addressed, the erosion of merit review will continue. A concerted effort -- by universities themselves as well as state and Federal Government -- to attack the facilities problem must be launched. For this, universities will indeed have to exert their political influence. But that influence must be directed at a long-term solution, not at the short-term and ultimately self-defeating steps of the past two years.

Too much is at stake to continue on the present course. As university facilities deteriorate, U.S. science and engineering will lose its grip on world leadership. If universities respond to deteriorating facilities by circumventing merit review, the decline in U.S. leadership will accelerate, and excellence will deteriorate into mediocrity.

To address these issues and to launch actions to solve them, the National Science Board:

a) Will continue to press the scientific community for strict self-regulation. It urges all professional societies, associations, academies, industry researchers, faculty and principal investigators to act in concert and support the peer review system.

b) Will evaluate the comprehensive merit review process, as part of a continuing process of scrutiny and improvement and as a reflection of the need to reassert the importance of the merit review system. Based on the evaluation, changes and improvements will be made, if required.

c) Calls for a Conference on Academic Research Facilities among the interested parties, to be sponsored by the NSB, the National Academies, and the Office of Science and Technology Policy. The conference should be held as soon as possible, utilizing talent from the financial community, Congress, state governments, federal agencies, academic institutions and business to define the problem and propose solutions.

APPENDIX A
NSB/C-84-7

NATIONAL SCIENCE BOARD
WASHINGTON, D.C. 20550

September 27, 1984

MEMORANDUM TO MEMBERS OF THE AD HOC COMMITTEE ON EXCELLENCE IN SCIENCE AND ENGINEERING

Dr. Charles E. Hess, Chairman
Dr. Rita R. Colwell
Dr. Peter T. Flawn
Dr. John H. Moore
Dr. Homer A. Neal

Subject: Charge to Committee

This is to confirm your appointment to the Ad Hoc Committee on Excellence in Science and Engineering. Your charge is to recommend the proper role and policy of the National Science Foundation in addressing the issue of educational institutions attempting to bypass merit-based peer review through the legislative process.

In considering this issue, the Committee should attempt to address some of the underlying factors that have given rise to the bypass initiatives by some educational institutions. It should also examine alternative solutions that might help solve the underlying problems, while maintaining a strict system of quality control on programs. An interim report should be brought to the Board in November, with a final report by February 1985.

Attached as background information is a memorandum from the Director to the Executive Committee containing his concerns and recent activities related to this issue.

Dr. Raymond E. Bye will serve as Executive Secretary to the Committee and Dr. Gerald F. Tape will serve as a Consultant.

Roland W. Schmitt
Chairman

Attachment

Dr. SCHMITT. Let me conclude by describing how we have restructured the National Science Board to increase its involvement in developing NSF policy and in national science policy in general.

To help the Foundation respond to human resource needs more effectively, we have established a Committee on Education and Human Resources to oversee the Foundation's efforts in science and engineering education. It will also address science and engineering personnel issues, including efforts to bring minorities, women, and the handicapped into science and engineering careers. And I am happy to say that Dr. Si Ramo has agreed to be chairman of that subcommittee.

To oversee NSF long-range planning and program implementation more effectively, we have established a Committee on Programs and Plans, which Dr. Mary Goode chairs.

We want to move away from reliance on approval of awards as the primary mechanism for NSB oversight of NSF programs. We are seeking your support of an amendment to the NSF Act that would eliminate any specification in law of an amount above which the Board could not delegate approval authority to the Director.

We worked very closely with Erich Bloch in devising the recent changes in the Board's structure. The National Science Board really can only be as effective and useful as the Director wants it to be and is willing to cooperate with it to make it. This Director made it very clear that he wants an active, strong Board, and indeed, it is a pleasure to work with him.

Finally, let me give you some examples of the tasks that the Board will take on during 1985. At the broadest level, we will work with the Director to develop NSF's goals, organizational philosophies, and future program direction. We will consider how NSF funds can be leveraged to encourage other agency and private sector contributions to science and engineering. We will also examine changes in the institutional framework for supporting university-based science and engineering; NSF's role in fundamental computational science in relation to other agencies, and the development of the initiatives that I just reviewed.

We will also continue our reviews of science in the international setting, and of research excellence and the breadth of research participation.

The question of how we can foster and maintain excellence in our research universities in the context of national needs and priorities is one that we, in fact, must all address.

The Board looks forward to working with Erich as he tackles these tasks and implements the strategic directions for the National Science Foundation that you have supported in recent years.

I would now like to turn to Erich for his testimony, and later, I will be happy to respond to questions.

Thank you.

The CHAIRMAN. Thank you.

[The prepared statement of Mr. Schmitt follows:]

NATIONAL SCIENCE BOARD
WASHINGTON, D.C. 20550

STATEMENT OF

DR. ROLAND W. SCHMITT

CHAIRMAN, NATIONAL SCIENCE BOARD

COMMITTEE ON LABOR AND HUMAN RESOURCES

U.S. SENATE

APRIL 30, 1985

Mr. Chairman and Members of the Subcommittee,

I am Roland W. Schmitt, Senior Vice President for Corporate Research and Development of the General Electric Company and Chairman of the National Science Board. It is in the latter capacity that I am testifying here today. It is my pleasure to join Erich Bloch in appearing before you to discuss the authorization of the FY 1986 budget for the National Science Foundation. I will summarize some of the science and engineering policy issues that bear on the strategy behind this budget, and some of the priorities it addresses.

Today the Nation faces heightened international competitive challenges--economic, military, and technological. This competition broadens demands on science and engineering research and education. These pressures make it more important than ever before to strengthen the science and engineering base that underlies all our technology efforts. That base determines the ability to perform forefront research, and to renew the Nation's supply of first-rate scientists and engineers. But at the very time demands are greatest, we face the prospect of deteriorating research and education capabilities in our great universities, due to shortages of faculty and of up-to-date equipment for instruction and research.

The Federal Government plays the leading role in supporting universities in their efforts to do research and provide personnel for the future. So, even in a time of necessarily constrained budgets and hard choices among many worthwhile goals, the President's FY 1986 budget attaches priority to the continuing need for strengthening the academic science and engineering base on which the Nation's economic and military security depend.

This need is being met by several recent initiatives that provide new environments and capabilities for strengthening research and education. The National Science Foundation has begun the process of creating Engineering Research Centers--a new form of university-industry cooperative research effort that puts cross-disciplinary teams of engineering faculty and undergraduate and graduate students to work on problems that combine intellectual excitement with economic value. The concept has received strong support from the President's Science Advisor, the National Science Board, the National Academy of Engineering, and industry. I urge your continued support of this new concept for gaining fundamental engineering knowledge while educating future engineers.

Another such initiative is the plan to establish advanced scientific computing centers, to enhance progress in many areas of science and engineering research and education. The computing revolution has created dramatic improvements in all aspects of doing science and technology, from experimentation to computer modeling to computer-aided design and engineering. Strengthening the science and engineering base requires making sure the next generation of scientists and engineers can use these tools. The proposed centers were judged in part on their close involvement with high quality research projects and their educational value in teaching students and researchers to use the most advanced computers.

Universities continue to experience severe problems in obtaining state-of-the-art research instrumentation. In response the NSF is continuing to increase support for instrumentation on all levels, from individual projects and investigators to national centers serving hundreds of scientists and engineers. First-rate instrumentation is essential, both for research and for the education of tomorrow's innovators and investigators.

Another major initiative, the Presidential Young Investigators Program, addresses the problem of faculty shortages. Universities need outstanding scientists and engineers in teaching positions if they hope to turn out outstanding graduates in science and engineering. But retaining those teachers is difficult, given the high demand for their skills in non-teaching jobs. The Presidential Young Investigators Program provides a big incentive for staying in teaching--NSF research funding and matching industrial support up to a total of $100,000 a year for five years. The Nation's engineering and science communities and its advanced-technology industries strongly support this program, and I urge your continued support for it.

Science and engineering education also needs strengthening, particularly at the precollege levels. As many of you know, this need has been voiced in many recent reports. The NSF is responding with new efforts to strengthen its science and engineering education programs, as Erich Bloch will describe to you in a moment. The National Science Board strongly supports those efforts.

And, finally, the past decade has witnessed a phenomenal expansion in biological science and technology. Continued American leadership here will depend on the strength of the science and engineering base. In response, the NSF is undertaking an initiative that will support biotechnology-related research underlying such goals as the improved growth and utilization of food and fiber crops, better medicines and diagnostic techniques, and improved production of specialty chemicals. The initiative will also support the education of the bio-engineers needed to assist the turning of basic knowledge into practical processes and products.

These are some of the initiatives meeting what I regard as the NSF's top priority--strengthening the Nation's science and engineering base. I would also like to note that the National Science Board recently approved a report and statement on the issue of educational institutions atempting to bypass merit-based review through the legislative process. The Board made three recommendations:

(1) It urged the Director and members of the National Science Board to continue to speak out on the self-defeating consequences of circumventing the merit review system, and urged all professional societies, associations, academies, industry researchers, faculty and principal investigators to act in concert and support merit review.

(2) It asked the Director to appoint a committee to review evaluation processes within the NSF, review other agencies' approaches and recommend any modifications that it judges desirable. The committee, to be chaired by Norman Hackerman, former Chairman of the National Science Board, will analyze how comprehensive merit review applies to diverse activities, such as general research grants, instrumentation awards, and special programs (e.g. international, women and minority programs).

(3) It called for a conference on Academic Research Facilities to be sponsored by the NSB, the National Academies, and the Office of Science and Technology Policy. The conference will draw on talent from the financial community, the Congress, state governments, federal agencies, academic institutions and business to define the problem and propose solutions. Emphasis will be placed on identification of novel financial approaches available to state governments and universities.

With your permission, I would like to submit copy of the Board's statement for the record.

Let me conclude by describing how we have restructured the National Science Board to increase its involvement in developing NSF policy, and in national science policy in general.

To help the Foundation respond to human resource needs more effectively, we have established a Committee on Education and Human Resources to oversee the Foundation's efforts in science and engineering education. It will also address science and engineering personnel issues, including efforts to bring minorities, women, and the handicapped into science and engineering careers.

To oversee NSF long-range planning and program implementation more effectively, we have established a Committee on Programs and Plans. We want to move away from reliance on approval of awards as the primary mechanism for NSB oversight of NSF programs. As you know, the NSF Act requires that the Board approve awards above amounts fixed in the statute. We are seeking your support of an amendment to the NSF Act that would eliminate any specification in law of an amount above which the Board could not delegate approval authority to the Director. We believe that by reducing the number of individual grants we are required to review based solely on the dollar limit, we can spend more of our time reviewing programs with special policy significance, such as the initiatives I spoke of previously. And we will be able to get involved earlier in the decisionmaking process.

We have worked very closely with Erich Bloch in devising the recent changes in the Board's structure, with the aim of involving the Board more fully in the substance of the Nation's science and engineering policy level problems, opportunities, and issues. The National Science Board can only be as effective and useful as the Director wants it to be. This Director has made it very clear that he wants an active, strong Board. It is a pleasure to work with him.

Finally, let me give you some examples of the tasks the Board will take on during 1985. At the broadest level, we will work with the Director to develop NSF's goals, organizational philosophy, and future program directions. We will consider how NSF funds can be leveraged to encourage other agency and private sector contributions to science and engineering. We will also examine changes in the institutional framework for supporting university-based science and engineering, NSF's role in fundamental computational science in relation to other agencies, and the development of the initiatives I just reviewed --science and engineering education, engineering research centers, advanced scientific computing, and so on. We will also continue our reviews of science in the international setting, and of research excellence and the breadth of research participation. The question of how we can foster and maintain excellence in our research universities in the context of national needs and priorities is one that we must all address.

The Board looks forward to working with Erich as he tackles these tasks and implements the strategic directions for the National Science Foundation that you have supported in recent years. I would now like to turn to Erich for his testimony. Later, I will be happy to respond to questions.

The Chairman. Mr. Bloch.

Mr. Bloch. Thank you.

I have a written statement, also, which I would like to submit for the record and take the opportunity just to highlight a few main points.

As the chairman pointed out before, this is a very tight budget year, and the Foundation has indeed fared well in the consideration leading up to the President's budget submission—which speaks well for the administration's continued support for the U.S. scientific enterprise, and I hope that Congress will concur in that particular judgment.

Nevertheless, we had hard choices to make, and choices reveal very much about one's priorities. Our first priority is to maintain and improve where possible the health of basic scientific and engineering research.

We also realize how important basic scientific and engineering research is to U.S. industry, to stay ahead of international competition, to avail itself of new processes, new materials and new equipment, and to exploit the rapid advances in new and emerging technology, and through research, educate and train young scientists and engineers for industry, government, and faculty in universities.

These concerns lead us to give priority to three major areas in developing the 1986 budget. The first one is increased support of programs that are most directly related to economic competitiveness. Engineering, for example, which is the key to converting scientific progress and technological breakthroughs into products and processes, is up by 13 percent, $270 million. Much of this increase will go to the engineering research centers.

For similar reasons, significant increases are planned in biotechnology, Earth sciences and advanced materials. Especially the latter is of ever-increasing importance to both established and emerging industry sectors.

Second, we will continue to improve the infrastructure of science in the universities—people, equipment, and facilities that are integral to research. Through the research grants, we are supporting over 14,000 graduate students and post-docs, a 4-percent increase over the last year. In addition, we support over 1,500 graduate fellowships and 500 Presidential Young Investigators.

Support for instrumentation is up 15 percent, to over $270 million, or 20 percent of our research-related budget. This is essential if we are to maintain the research leadership in this country. It is also a key factor driving up our grant sites.

Facilities such as the recently announced super-computer centers and engineering research centers will provide stimulating research environments for a large number of economic researchers.

The third priority involves those activities for which NSF has a special responsibility because it is a major source of Federal funds, such as mathematics and social and economic sciences. Both received increases for this particular reason.

Given these priorities in an austere budget year, we had certain other decisions to make. We are curtailing certain programs no longer in the mainstream or of secondary priority; stretching out large capital investment, and lowering administrative costs. Of course, we are continuing a strong effort to leverage funds by increasing participation from and cooperation among universities, the States, and industry, such as in the Presidential Young Investigator Program, the Engineering Research Center Programs, and the super-computer areas.

Let me highlight a few budget details and reflect and put in perspective increases over the last 4 years. Research and related activities are up 54 percent over this timeframe. All major research areas shared in the increase, both established research activities and the emerging research opportunities. The major component of the NSF activity is core research. Core research is a dynamic assembly of programs—and we took a hard look at these programs as part of the 1986 budget preparation, and we reduced or terminated funding for programs that are no longer competitive.

With the freed-up funds, we have provided for exciting new research opportunities, such as biotechnology, materials research, and a new ocean-drilling program, and these are the increases for these particular programs.

We continue to make these evaluations and make hard decisions to assure Congress and ourselves that the best, most promising research opportunities are properly funded.

The U.S. Antarctic Program is up 75 percent over the last 4 years. It has grown because of our central role in coordinating all research activities in the Antarctic, a responsibility transferred to the Foundation by the President in 1983. Most of the funding, about 90 percent, has gone for equipment and facilities in that particular region.

Science and engineering education is up 292 percent since 1982. After many ups and downs for that particular directorate, we are now building a solid foundation, especially for pre-college activities. I will talk more about this in a minute.

Several initiatives are being continued and increased. Support for predominantly undergraduate institutions aimed about four-year institutions is up to $44 million in 1986. The Presidential Young Investigator Awards will increase to $30 million, providing support for 500 of the Nation's finest young science and engineering Ph.D.'s. It is a positive influence on their faculty careers.

Advanced scientific computing is increasing to $46 million, providing scientists and engineers with access to super-computer centers and universities.

We recently announced four center awards—Illinois, Cornell, the University of California at San Diego, and the Von Hoyman Center in New Jersey, with a consortium of 12 universities including Princeton and MIT. The fifth one, using a NASA computer provided by Congress, is under discussion.

The Engineering Research Centers, will climb to $25 million, with up to 10 centers by the end of 1986, providing opportunities for cross-disciplinary teams to respond to emerging issues, training of students, and stimulating participation between industry and academia. The first awards, after reviewing 142 proposals were granted on April 3. It involved six centers—a robotics systems center at the University of California at Santa Barbara; a telecommunications center at Columbia University; a composite manufacturing center at the University of Delaware in collaboration with

Rutgers, and a systems research center at the University of Maryland in collaboration with Harvard University; a biotechnology process engineering center at MIT, with cooperation from NIH for the funding of that particular center; an intelligence manufacturing systems center at Purdue University.

The interest generated suggests that even unsuccessful applicants will use this particular model in their own limited way, together with industry and the States.

I need to single out and discuss in more detail the education program. It is important to review the funding trend over the last decade because of changes that have occurred.

Prior to 1982, the pre-college and college-level activities had numerous underfunded and fragmented programs not adequately coupled to each other or to State and local education programs.

In 1982, funding was virtually terminated because of serious concerns that activities were no longer contributing significantly to the quality of science and engineering education.

Since 1983, we have been rebuilding the pre-college activities to provide leadership and serve as a catalyst in developing course materials, innovative teacher activities, and support for out-of-school activities. This funding has increased from $1 million in 1983 to about $50 million in 1985 and 1986.

But gearing up takes time, especially if we are to build a current program and a coherent program that addresses pre-college science and math issues while maintaining our standard of excellence. We must also provide a base for future years' activities.

We are addressing these issues in 1985. We recently finished completely rebuilding our science education staff, and organization so that we may effectively deal with the issues at hand. We will complete by May 31 the goal-oriented strategic plan that will define specific problems and pockets of opportunity. This plan will focus on areas that can benefit from effective NSF presence over the next several years.

We have advertised our intention to issue an RFP for the development of a series of comprehensive, long-range management plans. These plans will provide us with the tools to ensure that our relatively small but catalytic effort is effectively coupled with the multibillion dollar annual investment in pre-college education by other Federal agencies, by State, local and private sources.

These studies should be completed with the next 12 months.

All of these planning efforts are helping us plan the actions necessary for the National Science Foundation to provide continuing leadership in science education. Such continuity and stability will encourage good partnerships to form and become productive.

We have seen and funded many excellent proposals, but even a collection of excellent proposals does not necessarily make for a cohesive program that can be effectively managed and coupled to the needs of the Nation's schools and teachers. We expect this to change over the next years as the program objectives become more clearly defined through the planning process and more focused proposals will be solicited and funded.

For these reasons, we can prudently spend the $50 million and have proposed a $30 million carryover into 1986. We plan to carry over this form of $31 million in the pre-college area into next year.

In addition, the 4-year college instrumentation program at $5 million, plus matching by the private sector, provides important equipment to the undergraduate institutions. Over time, we may want to increase the matching requirements.

The fellowships have been maintained throughout the decade and are now supporting over 1,500 graduate fellows. With increases in stipends to $11,000 per year, the program is very attractive to the Nation's promising young scientists and engineers.

I would like to discuss briefly the Education for Economic Security Act which the Congress passed and the President signed into law last year. As you know, the act is designed to improve mathematics and science education in this country. Many of the policies and programs that act authorizes are consistent with the President's program for 1985 and the National Science Foundation programs. In 1985, we are implementing such programs to the extent the appropriations allow. We are emphasizing partnerships between universities, local and State governments, and the Federal Government. We are stressing cooperation between the departments of mathematics and science and the Department of Education. We are providing opportunities to segments of the population under-represented in science and engineering.

Even so, the administration will not seek authorization of titles I and III of the act in 1986. The President's proposed budget request for 1986 continues a momentum started in 1985 to establish the proper mix of programs and provide for orderly growth.

I want to assure this committee that science education remains one of the Foundation's highest priorities, and I will continue to work with you and your staff and this committee to see that these goals are met.

In summary, Mr. Chairman, much discussion and hard decisions have gone into formulating this request. As a result, it represents a balanced indicated approach—a balance between single investigators and large facilities, between human resources and equipment, between traditional research activities and critical new and emerging areas. We believe this strategy is essential to maintaining and improving an increasingly complex scientific enterprise. It is a strategy which speaks to the future, not just the present. The ideas, people and equipment that we support today will provide the scientific and engineering leadership of tomorrow.

I respectfully ask for this committee's support for our programs and our budget, and we will both be happy to answer any questions you might have.

Thank you very much.

The **Chairman**. Thank you very much.

[The prepared statement of Mr. Bloch follows:]

National
Science
Foundation

STATEMENT OF

MR. ERICH BLOCH

DIRECTOR, NATIONAL SCIENCE FOUNDATION

BEFORE THE

COMMITTEE ON LABOR AND HUMAN RESORCES

U.S. SENATE

APRIL 30, 1985

Mr. Chairman and Members of the Committee:

It is a pleasure to be here this morning to talk about the National Science Foundation. This is my first appearance before you as Director of the Foundation, and I look forward to discussing our proposed programs for 1986 in this hearing.

First, I would like to introduce Dr. Roland Schmitt, Chairman of the National Science Board and Vice President of Corporate Research and Development for the General Electric Corporation. Dr. Schmitt will briefly describe to you some of the priorities and issues that are of concern to the Board.

Dr. Schmitt

The National Science Foundation meets its responsibility for the health of the scientific enterprise by supporting the most promising fundamental, long-term research by the best minds in all fields of science and engineering.

The principal products are:

- New knowledge and discoveries from the cutting edge of research, and
- The education and training of the world's most talented and creative scientists and engineers.

Gaining a new and deeper understanding of nature, and replenishing our supply of scientists and engineers are essential if we are to improve the Nation's industrial competitiveness, defense, economy, health and general well-being of our citizens.

In my discussion today I will focus on:

- The challenges facing the scientific community, and the implications these have for the social and economic fabric of the U.S.
- The Federal role, and in particular, the responsibilities of the National Science Foundation for scientific and engineering research.
- The strategy the Foundation pursues to meet these responsibilities, and carry out this Administration's strong policy for basic research.

Lastly, I will highlight the proposed budget for 1986, and discuss several activities in greater detail.

Challenges for Research

As I see it, there are three major challenges facing us:

- The increasing complexity of scientific and engineering research
- resource needs and shortages
- world competition in key research areas.

Complexity and change are not new to science and engineering; but the complexity in research is greater and the rate of change is increasing in every aspect of science and engineering research compared to the past. We see this not only in the problems we have identified for study, but in the research process as well.

Analytical techniques and instrumentation are increasing in power, sophistication and cost. Yet, we must utilize these techniques if we are to explore, observe, and understand phenomena characterized by smaller scales, shorter times, and weaker signal strengths. Electron microscopes, radio telescopes and supercomputers have high price tags, but are absolutely essential if we are to continue to expand our base of scientific knowledge.

WE ARE ALSO BEGINNING TO EXPERIENCE BREAKDOWNS OF THE BARRIERS BETWEEN TRADITIONAL DISCIPLINES AND FIELDS. WE CAN SEE THIS CLEARLY IN SUCH AREAS AS BIOTECHNOLOGY, MATERIALS SCIENCE, ENGINEERING AND COMPUTER SCIENCE. AT THE INTERFACE OF DISCIPLINES AND FIELDS IS WHERE MAJOR RESEARCH PROGRESS OFTEN IS MADE AND NEW TECHNOLOGIES EMERGE.

THE COMPLEXITY AND INCREASE IN THE RATE OF CHANGE DEMAND CONSTANT COMMUNICATION MAKE IT NECESSARY TO BRING TOGETHER SCIENTISTS FROM TRADITIONALLY DISTANT DISCIPLINES TO SHARE AND EXCHANGE KNOWLEDGE, SKILLS, RESOURCES, AND EQUIPMENT.

THIS CHANGING ENVIRONMENT WILL, IF HARNESSED PROPERLY, HAVE A POSITIVE EFFECT ON SCIENCE AND ENGINEERING KNOWLEDGE AND RESEARCH.

- BASIC RESEARCH RESULTS WILL BE SHARED, CROSS-STIMULATING AND ACCELERATING NEW RESEARCH OPPORTUNITIES,

- NEW INSTITUTIONAL RELATIONSHIPS WILL DEVELOP, FOSTERING MORE COOPERATION--AND PARTICIPATION--AMONG INDUSTRY, ACADEMIA, AND GOVERNMENT.

THE COMPLEXITY OF SCIENTIFIC AND ENGINEERING RESEARCH OFFERS UNLIMITED OPPORTUNITIES FOR EXPANDING OUR KNOWLEDGE AND CONTRIBUTING ULTIMATELY TO MAJOR IMPROVEMENTS IN OUR QUALITY OF LIFE. THE MORE WE KNOW, THE MORE WE WANT TO KNOW. AND AS WE LEARN, WE FIND MORE THINGS WE MUST LEARN ABOUT.

BUT, CLEARLY, THERE ARE CONSTRAINTS, AND ONE THAT WE ALL FACE -- AS INDIVIDUALS AND PUBLIC OFFICIALS -- IS RESOURCE AVAILABILITY.

THIS SAME CONSTRAINT EXISTS IN SCIENCE AND ENGINEERING RESEARCH. THE NATION NEEDS AN ADEQUATE SUPPLY OF PROFESSIONALS FOR INDUSTRY, GOVERNMENT, AND ACADEMIA, ESPECIALLY IN THE EMERGING SCIENCE AREAS.

THIS REQUIRES THAT WE NOT ONLY MAINTAIN A STIMULATING YET COMPETITIVE ENVIRONMENT FOR EXISTING SCIENTISTS AND ENGINEERS, BUT ALSO AN ENVIRONMENT THAT ENCOURAGES OUR YOUNG STUDENTS--THE SCIENTISTS AND ENGINEERS OF TOMORROW -- TO SEEK CAREERS IN ALL FIELDS OF SCIENCE AND ENGINEERING.

FINANCIAL RESOURCES ARE ALSO EXTREMELY IMPORTANT, ESPECIALLY WITH THE NEED FOR COSTLY INSTRUMENTATION, EQUIPMENT, AND FACILITIES NECESSARY TO CARRY OUT BASIC RESEARCH. BUT THEY MUST BE EFFICIENTLY AND EFFECTIVELY USED; WE CANNOT AFFORD THE LUXURY OF "THROWING DOLLARS AT RESEARCH." ON THE OTHER HAND, WE CANNOT BYPASS EXPENSIVE RESEARCH SIMPLY BECAUSE IT IS EXPENSIVE. WHAT WE MUST DO IS MAKE CHOICES, AND WE DO THIS BY ASSURING EXCELLENCE, SETTING PRIORITIES, AND FOCUSING ON IMPORTANT LINES OF INQUIRY.

THE THIRD CHALLENGE, WORLD COMPETITION, COMES IN MANY FORMS. WE, OF COURSE, ARE MOST FAMILIAR WITH ECONOMIC COMPETITION, BUT THERF IS COMPETITION IN RESEARCH ALSO. THIS NATION HAS ALWAYS HAD A LEADERSHIP ROLE IN TECHNOLOGY, DEVELOPED THROUGH THE HEALTH AND STRENGTH OF OUR RESEARCH BASE. THIS HAS ENABLED US TO MAINTAIN AND INCREASE PRODUCTIVITY.

BUT, THERE IS AN INCREASED REALIZATION BY INDUSTRIALIZED NATIONS THAT SCIENCE AND TECHNOLOGY ARE AT THE HEART OF ECONOMIC PROGRESS. AS A RESULT, WE ARE BEGINNING TO SEE RESEARCH EFFORTS EMPHASIZED BY FOREIGN TRADING PARTNERS, CHALLENGING THE U.S. LEADERSHIP ROLE IN EMERGING FIELDS SUCH AS SUPERCOMPUTERS AND BIOTECHNOLOGY.

EMERGING NATIONS ARE EMULATING THE SUCCESS OF INDUSTRIALIZED NATIONS BY CONVERTING RESEARCH RESULTS INTO MARKETABLE TECHNOLOGY.

WE MUST CONTINUE TO BE COMPETITIVE BY KEEPING OUR RESEARCH AND TECHNOLOGY ON THE CUTTING EDGE, AND BY BEING FIRST IN TRANSLATING RESEARCH RESULTS INTO PRODUCTS IN THE MARKETPLACE. CLEARLY, WE MUST WORK HARD TO MAINTAIN OUR PREEMINENCE IN SCIENCE AND ENGINEERING RESEARCH AND TECHNOLOGY; WE CANNOT TAKE IT FOR GRANTED.

THE THREE CHALLENGES -- COMPLEXITY, RESOURCE AVAILABILITY AND WORLD COMPETITION -- MUST BE MET SUCCESSFULLY IF WE ARE TO MAINTAIN A STRONG, GROWING INDUSTRIAL BASE FOR OUR NATION, AND CONTINUED IMPROVEMENTS IN THE QUALITY OF LIFE.

TODAY, THERE IS RESOLVE TO MEET THESE CHALLENGES HEAD ON. THERE IS GREATER PUBLIC AWARENESS THAT BASIC SCIENTIFIC AND ENGINEERING RESEARCH IS IMPORTANT TO MAINTAINING ECONOMIC GROWTH AND IMPROVING THE QUALITY OF LIFE, AND A MORE COOPERATIVE ENVIRONMENT AMONG INDUSTRY, ACADEMIA AND GOVERNMENT, READY TO SHARE IN THE RESPONSIBILITY TO MAINTAIN SCIENTIFIC LEADERSHIP.

2. ROLE OF GOVERNMENT AND THE NSF

IF ADVANCING SCIENCE AND TECHNOLOGY IS AN IMPORTANT PART OF THE ANSWER, THEN WE MUST ASK: WHOSE RESPONSIBILITY IS IT TO DO THE RESEARCH? TRAIN PEOPLE? PROVIDE FUNDING?

SOME YEARS AGO, THE RESPONSIBILITY MIGHT WELL HAVE BEEN PLACED SQUARELY ON THE SHOULDERS OF THE FEDERAL GOVERNMENT. BUT THERE IS A GROWING REALIZATION THAT MANY PARTNERS -- INCLUDING THE FEDERAL GOVERNMENT, INDUSTRY, STATE AND LOCAL GOVERNMENTS, AND UNIVERSITIES -- HAVE A STAKE IN THE OUTCOME, AND THAT EACH HAS A ROLE TO PLAY AND MUST BE AN ACTIVE PARTICIPANT IF WE ARE TO REALIZE MAXIMUM BENEFITS.

LET ME BRIEFLY DESCRIBE WHAT PART OTHER MAJOR PLAYERS HAVE IN SCIENTIFIC AND ENGINEERING RESEARCH.

- UNIVERSITIES HAVE A DUAL ROLE: TO EDUCATE AND THROUGH RESEARCH, CONTRIBUTE TO THE KNOWLEDGE POOL. THESE TWO ROLES ARE NOT SEPARATE. RESEARCH IS AN EDUCATIONAL TOOL AND IT TAKES EDUCATED PEOPLE TO DO RESEARCH.

- INDUSTRY HAS A STAKE IN BASIC RESEARCH BECAUSE SUCH RESEARCH PROVIDES THE BASIS FOR NEW DEVELOPMENTS AND INNOVATION, AND, ULTIMATELY, NEW PRODUCTS AND SERVICES.

- STATE AND LOCAL GOVERNMENTS BEAR RESPONSIBILITY FOR EDUCATION AND ECONOMIC DEVELOPMENT WITHIN THEIR GEOGRAPHIC REGIONS. THEY MUST ENSURE THAT THEIR EDUCATION PROGRAMS AND FACILITIES PROVIDE WELL-EDUCATED AND TRAINED GRADUATES WHO WILL ATTRACT AND PROMOTE ECONOMIC DEVELOPMENT AND EXPANSION.

LET ME NOW TURN TO THE FEDERAL ROLE IN SUPPORTING BASIC RESEARCH. THE FEDERAL GOVERNMENT PROVIDES ABOUT 67% OF BASIC RESEARCH SUPPORT, RESEARCH WHICH ULTIMATELY BENEFITS THE ENTIRE NATION IN THE LONG TERM ACROSS A BROAD AND VARIED SPECTRUM OF PRODUCTS AND SERVICES THAT MAINTAIN AND IMPROVE THE QUALITY OF LIFE.

THIS NATIONAL PERSPECTIVE ALLOWS US TO:

- NURTURE PROMISING NEW AND EMERGING SCIENCE AND ENGINEERING RESEARCH WITHOUT LOOKING EXCLUSIVELY FOR IMMEDIATE AND HIGH RETURNS. OUR PAYBACK WILL COME IN THE KNOWLEDGE THAT OUR INVESTMENTS IN BASIC RESEARCH TODAY WILL IMPROVE LIFE FOR OUR CHILDREN AND GRANDCHILDREN.

- DEVELOP AND MAINTAIN MAJOR BASIC RESEARCH FACILITIES THAT SERVE THE COMPLEX, MULTIDISCIPLINARY REQUIREMENTS OF TODAY'S RESEARCH. EXPENSIVE EQUIPMENT, ACCELERATORS, SHIPS, TELESCOPES, AND SUPERCOMPUTERS -- MUST BE SHARED IF THEY ARE TO BE JUSTIFIED AND PROPERLY UTILIZED.

- DRAW ON THE BEST SCIENTIFIC AND ENGINEERING TALENT AVAILABLE.

3. NSF GOALS AND STRATEGY

NOW WHAT ABOUT THE GOALS AND STRATEGIES OF THE NATIONAL SCIENCE FOUNDATION? WHAT CAN WE DO TO MEET THESE CHALLENGES, AND CARRY OUT THIS ADMINISTRATION'S AND THE CONGRESS' STRONG POLICY AND FUNDING SUPPORT FOR BASIC SCIENTIFIC AND ENGINEERING RESEARCH?

THE FIRST GOAL IS EXCELLENCE. IN SCIENCE AND ENGINEERING RESEARCH, AS IN ANY CREATIVE ENDEAVOR, THE BEST IS VASTLY MORE VALUABLE THAN THE MERELY GOOD.

- EXTERNALLY, IN OUR GRANTS AND CONTRACTS FOR RESEARCH, EXCELLENCE MEANS MERIT-BASED PEER REVIEW. IT IS STILL THE BEST WAY TO ENSURE HIGH QUALITY AND THE BEST RETURN FOR THE NATION'S INVESTMENT.

- INTERNALLY, WITHIN THE FOUNDATION, WE WILL CONCENTRATE ON GOOD MANAGEMENT, USING AUTOMATION WHERE POSSIBLE TO IMPROVE OUR EFFICIENCY.

SECOND, THE FOUNDATION MUST BE A CATALYST FOR CHANGE IN THE SCIENTIFIC AND ENGINEERING COMMUNITY. THIS MEANS NOT ONLY PURSUING NEW RESEARCH OPPORTUNITIES, BUT ALSO ENCOURAGING NEW WAYS TO CARRY OUT SUCH RESEARCH.

- APPLYING INTERDISCIPLINARY APPROACHES TO NEW AND EMERGING RESEARCH POSSIBILITIES.

- DEVELOPING NEW RELATIONSHIPS BETWEEN GOVERNMENT AND PRIVATE INSTITUTIONS, AND BETWEEN INDUSTRY AND UNIVERSITIES.

- INCREASING COMMUNICATION, STIMULATING THE SHARING OF EXPENSIVE EQUIPMENT, FACILITIES, AND KNOWLEDGE.

WHILE WE MAY ENCOURAGE SCIENCE AND ENGINEERING RESEARCH TO MOVE IN NEW DIRECTIONS IN A CONCERTED WAY, WE MUST AND WILL CONTINUE TO SUPPORT INDIVIDUAL RESEARCH PROJECTS CARRIED OUT BY A PRINCIPAL INVESTIGATOR AND A FEW STUDENTS. IT IS A SIMPLE YET MOST EFFECTIVE STRATEGY.

THE KEY IS TO BALANCE THIS WITH LARGE-SCALE COOPERATIVE EFFORTS. THERE IS AMPLE OPPORTUNITY AND NEED FOR BOTH: IT IS NOT A QUESTION OF ONE APPROACH OR THE OTHER.

THIRD, NSF MUST TRY TO IMPROVE THE HEALTH OF THE SCIENCE AND ENGINEERING INFRASTRUCTURE. INSTRUMENTATION, SPECIAL FACILITIES INTEGRAL TO RESEARCH AND HUMAN RESOURCES MUST BE THE BEST IF WE ARE TO REVITALIZE THE ACADEMIC RESEARCH BASE. WE WILL CONTINUE TO SUPPORT NEW AND ENHANCED INSTRUMENTATION AND ACCESS TO IT.

FOURTH, WE MUST CONTINUE TO HELP ATTRACT, EDUCATE, AND TRAIN STUDENTS FOR SCIENCE AND ENGINEERING. WE ARE DOING THIS THROUGH:

- FELLOWSHIPS OPEN TO ALL QUALIFIED APPLICANTS;
- SPECIAL PROGRAMS DIRECTED AT MINORITIES, WOMEN, AND THE HANDICAPPED;
- PROGRAMS DESIGNED TO ATTRACT AND RETAIN FACULTY IN DISCIPLINES WHERE FACULTY SHORTAGES IMPEDE BASIC RESEARCH PROGRESS;
- PROGRAMS KEYED TO THE IMPROVEMENT OF PRECOLLEGE SCIENCE AND MATHEMATICS EDUCATION; AND
- INCREASED SUPPORT TO UNDERGRADUATE AND GRADUATE STUDENTS THROUGH RESEARCH PROJECTS.

FINALLY, WE WILL CONTINUE TO LEVERAGE GOVERNMENT FUNDS WITH PRIVATE SECTOR, STATE AND LOCAL GOVERNMENT, AND ACADEMIC SUPPORT IN ALL AREAS WHERE COOPERATION IS A POSSIBILITY AND IN THE BEST INTERESTS OF ALL PARTICIPANTS.

TO MOVE TOWARD THESE GOALS, GIVEN THE BUDGET ENVIRONMENT FOR FY 1986, THE FOUNDATION MADE DECISIONS TO MAXIMIZE THE IMPACT OF FUNDING AVAILABLE FOR ACADEMIC SCIENTIFIC AND ENGINEERING RESEARCH ACTIVITIES, BY:

- RECOGNIZING THE NEED AND THE ADMINISTRATION'S RESOLVE TO REDUCE ADMINISTRATIVE COSTS. WE ARE HOLDING DOWN NSF'S ADMINISTRATIVE COSTS WHICH ARE ALREADY LOW COMPARED TO THOSE OF SIMILAR ORGANIZATIONS.

- CURTAILING PROGRAMS THAT ARE NOT IN THE MAINSTREAM OF SCIENTIFIC AND ENGINEERING RESEARCH.

- STRETCHING OUT CONSTRUCTION AND ACQUISITION OF SEVERAL MAJOR RESEARCH PROJECTS SUCH AS THE VLBA.

- MAKING TRADE-OFFS WITH ONGOING BASE PROGRAMS IN ORDER TO PROVIDE FOR ENHANCEMENTS IN SEVERAL KEY AREAS WHERE RESEARCH IS ESSENTIAL TO THE NATION'S PURSUIT OF SCIENTIFIC AND TECHNOLOGICAL EXCELLENCE AND TO THE TRAINING THE NEXT GENERATION OF SCIENTISTS AND ENGINEERS.

4. NSF BUDGET REQUEST

NSF'S FY 1986 BUDGET REQUEST CONTINUES THE MOMENTUM ESTABLISHED BY THIS ADMINISTRATION, AND SUPPORTED BY CONGRESS, TO KEEP U.S. SCIENTIFIC AND ENGINEERING RESEARCH AT THE LEADING EDGE.

THE FOUNDATION'S FY 1986 BUDGET REQUEST TOTALS $1,569.4 MILLION OR 4.4% ABOVE THE FY 1985 CURRENT PLAN OF $1,502.7 MILLION. IT INCLUDES:

- $1,397.8 MILLION FOR RESEARCH AND RELATED ACTIVITIES, AN INCREASE OF 7.4%.

- $120.1 MILLION FOR THE U.S. ANTARCTIC PROGRAM, UP 8.4%.

- $50.5 MILLION OF NEW OBLIGATIONAL AUTHORITY FOR SCIENCE AND ENGINEERING EDUCATION WHICH, COMBINED WITH A DEFERRAL OF $31.5 MILLION FROM FY 1985, PROVIDES TOTAL RESOURCES OF $82.0 MILLION, THE SAME LEVEL AS 1985.

THIS BUDGET REQUEST, IF APPROVED BY CONGRESS:

- MAINTAINS SUPPORT AT CURRENT LEVELS FOR RESEARCH OF PROVEN QUALITY ACROSS ALL DISCIPLINES.

- INCREASES SUPPORT FOR RESEARCH RELATED TO U.S. ECONOMIC COMPETITIVENESS SUCH AS ENGINEERING RESEARCH CENTERS, AND BIOTECHNOLOGY.

- INCREASES RESEARCH PROGRAMS THAT PROVIDE THE BASIS FOR ADVANCES IN SCIENCE AND TECHNOLOGY, INCLUDING THE SPECIFIC FACILITIES THAT ARE AN INTEGRAL PART OF THE PROPOSED RESEARCH. SOME FACILITY ACTIVITIES, HOWEVER, WHILE CONTINUING TO BE FUNDED WILL CONTINUE AT A SOMEWHAT SLOWER PACE THAN ORIGINALLY PLANNED.

- FOCUSES PRESIDENTIAL YOUNG INVESTIGATOR AWARDS ON FACULTY YOUNGER THAN PREVIOUS RECIPIENTS AND PROVIDES AN ADDITIONAL $6.0 MILLION TO SUPPORT 100 NEW AWARDS IN 1986, BRINGING THE TOTAL TO 500.

THESE ARE SOME OF THE HIGHLIGHTS OF OUR 1986 REQUEST. THERE ARE SEVERAL ACTIVITIES THAT I WOULD LIKE TO DISCUSS IN GREATER DETAIL.

SCIENCE AND ENGINEERING EDUCATION (SEE)

THE FY 1986 PROGRAM TOTAL FOR SEE IS $82.0 MILLION. THIS TOTAL INCLUDES AN FY 1986 REQUEST FOR NEW OBLIGATIONAL AUTHORITY OF $50.5 MILLION AND DEFERRAL OF $31.5 MILLION FROM FY 1985. WITH THE DEFERRAL, THE FY 1986 PROGRAM TOTAL REMAINS THE SAME AS THE FY 1985 LEVEL.

DEFERRAL

IN RECENT CORRESPONDENCE WITH AND IN HEARINGS BEFORE THE CONGRESSIONAL AUTHORIZATION AND APPROPRIATION COMMITTEES, WE HAVE SAID THAT IT IS UNLIKELY WE WILL REACH OUR EARLIER GOAL OF FULL EXPENDITURE OF ALL SEE FUNDS (I.E., $113 MILLION) IN FY 1985, ESPECIALLY IN THE PRECOLLEGE PROGRAMS. WE WILL MEET OUR PREVIOUS GOALS IN THE GRADUATE FELLOWSHIPS AND COLLEGE SCIENCE INSTRUMENTATION PROGRAMS. HOWEVER, WE ARE ENCOUNTERING PROBLEMS IN THE PRECOLLEGE AREA.

There are several reasons for this. First, funding levels in the precollege area have oscillated considerably over the past decade. In the 1973 to 1981 period, precollege funding was about $20 million per year; then it dropped to $3.4 million in FY 1982 and $1.1 million in FY 1983; and increased to about $68 million in available resources in FY 1984.

Neither the affected science and mathematics community nor NSF was ready for such an increase after FY 1982 and 1983. The result in FY 1984 was that we were able to spend $37.1 million, but had to carry over a $31.5 million balance into FY 1985. This carryover, plus the additional $49.7 million in newly appropriated funds for precollege activities, gave us a total of $82.0 million to obligate for those activities in FY 1985.

Gearing up to handle increases of this magnitude takes time, especially if we are to build a coherent program that addresses precollege science and math issues while maintaining our standard of excellence. The program also needs to provide a base for future years' activities.

We are addressing these issues in 1985.

o We have only recently finished completely rebuilding our staff and organization, providing adequate expertise and skill levels to deal with science education issues.

o We are finalizing a goal oriented strategic plan that will define specific problems and targets of opportunity. This plan, which we expect to complete by May 31, 1985, will focus on areas that can benefit from effective NSF presence over the next several years.

o We are preparing a Request for Proposal (RFP) for the development of a series of comprehensive, long-range management plans that will effectively couple our relatively small but catalytic effort to the mutli-billion dollar annual investment in precollege education by other Federal agencies, and by state, local, and private sources. These studies should be completed within the next year.

THESE PLANNING EFFORTS ARE HELPING US LAY OUT THE ACTIONS NECESSARY FOR THE NSF TO PROVIDE CONTINUING LEADERSHIP IN SCIENCE EDUCATION. SUCH CONTINUITY AND STABILITY WILL ENCOURAGE GOOD PARTNERSHIPS TO FORM AND BECOME PRODUCTIVE.

WE HAVE SEEN AND FUNDED MANY EXCELLENCT PROPOSALS, BUT IN SOME CASES EVEN A COLLECTION OF EXCELLENT PROPOSALS DOES NOT NECESSARILY MAKE A COHESIVE, WELL-MANAGED PROGRAM THAT IS EFFECTIVELY COUPLED TO THE NATION'S SCHOOLS AND TEACHERS.

WE EXPECT THIS SITUATION TO CHANGE OVER THE NEXT SEVERAL YEARS. AS THE PROGRAM OBJECTIVES BECOME MORE CLEARLY DEFINED THROUGH THE PLANNING PROCESS, MORE FOCUSSED PROPOSALS WILL BE SUBMITTED AND FUNDED.

BUT AT THIS POINT, WE CAN PRUDENTLY OBLIGATE ONLY $50.5 MILLION IN THE PRECOLLEGE PROGRAMS IN 1985. THUS, WE ARE PROPOSING THE $51.5 MILLION DEFERRAL AS A PLANNED CARRYOVER IN 1986. WE BELIEVE IT IS GOOD MANAGEMENT TO CARRY FORWARD FUNDS THAT WE WILL NOT BE ABLE TO EFFECTIVELY OBLIGATE IN 1985.

THE EDUCATION FOR ECONOMIC SECURITY ACT (P.L. 98-377)

AS YOU KNOW, LAST YEAR THE CONGRESS PASSED, AND THE PRESIDENT SIGNED INTO LAW THE EDUCATION FOR ECONOMIC SECURITY ACT, A BILL TO IMPROVE MATHEMATICS AND SCIENCE EDUCATION IN THIS COUNTRY. NSF STRONGLY SUPPORTS THE STATED PURPOSE AND EVIDENT INTENT OF THE ACT. MUCH OF THE POLICY AND MANY OF THE PROGRAMS AUTHORIZED BY THAT ACT ARE VERY SIMILAR TO THE PROGRAMS PROPOSED FOR NSF BY THE PRESIDENT FOR FY 1985, AND WE ARE ACTIVELY IMPLEMENTING THEM TO THE EXTENT APPROPRIATIONS ALLOW. FOR EXAMPLE:

o THE EMPHASIS ON PARTNERSHIPS AMONG UNIVERSITIES, LOCAL AND STATE GOVERNMENT, INDUSTRY, AND THE FEDERAL GOVERNMENT IS IMPORTANT. I HAVE SPOKEN FREQUENTLY ON THIS NEED IN OTHER CONTEXTS. IT IS EMBODIED IN OUR PROGRAM GUIDELINES FOR

Science and Engineering Education (SEE) and in other programs such as Presidential Young Investigators and Engineering Research Centers.

- o The stress on improving cooperation between departments of mathematics and science and departments of education is another point of agreement.
- o The emphasis on providing services to segments of the population which are underrepresented in science and engineering is a longstanding priority of the Foundation which is embodied in many programs.

Since there was no appropriation that accompanied this Act, we are not implementing those provisions of the Act that differ from the President's program for 1985. This applies in particular to specific administrative requirements concerning cost sharing, joint submission of proposals, distribution requirements, and funding ceilings.

Even though the Administration will not seek authorization of Titles I and III of the Act in 1986, the President's proposed budget request for 1986 continues the momentum started in 1985 to establish the most effective mix of programs and provide for orderly growth.

Science Education remains one of the Foundation's highest priorities, and we will continue to work to see that the goals of the Foundation's program are met.

Education and Training

This country requires a constant supply of talented young students and graduates if we are to maintain our leadership role in scientific and engineering research.

NSF makes a significant contribution to ensure this supply of human resources.

WE HAVE DIRECT SCIENCE AND ENGINEERING EDUCATION PROGRAMS, AND THROUGH RESEARCH GRANTS, PROVIDE OPPORTUNITIES FOR YOUNG SCIENTISTS AND ENGINEERS NOT ONLY TO ENHANCE THEIR EDUCATION, BUT ALSO TO TRAIN WITH SENIOR RESEARCHERS AND SOPHISTICATED INSTRUMENTS.

ALL EDUCATION LEVELS ARE ADDRESSED.

OUR SCIENCE AND ENGINEERING EDUCATION (SEE) ACTIVITY PLACES SPECIAL EMPHASIS ON SCIENCE AND MATHEMATICS PROGRAMS AT THE ELEMENTARY AND JUNIOR HIGH SCHOOL LEVELS. AT THE SAME TIME, SUPPORT WILL CONTINUE FOR PROMISING PROGRAMS AT THE HIGH SCHOOL LEVEL.

IT IS EXTREMELY IMPORTANT TO NURTURE BUDDING SCIENCE INTERESTS IN YOUNG STUDENTS. ONE OF THE MOST SUCCESSFUL EDUCATIONAL SHOWS SPONSORED BY NSF FOR TELEVISION IS "3-2-1 CONTACT". THIS PUBLIC TELEVISION SERIES ABOUT SCIENCE, FOR 8 TO 12 YEARS OLDS, IS BROADCAST DAILY ON MOST OF THE 280 PUBLIC TV STATIONS, AND IS USED IN THE MORNING BY SCHOOLS. IT HAS WON A NUMBER OF AWARDS, STIMULATED MANY SCIENCE RELATED ACTIVITIES ACROSS THE U.S., AND GENERATED, WITHOUT GOVERNMENT FUNDING, APPROXIMATELY 700,000 READERS OF "3-2-1 CONTACT" MAGAZINE.

AT THE UNDERGRADUATE LEVEL, WE SUPPORT APPROXIMATELY 3,000 STUDENTS PARTICIPATING IN RESEARCH GRANTS, HELP WITH INSTRUCTIONAL EQUIPMENT NEEDS AT THE NATION'S FOUR-YEAR COLLEGES, AND FUND FACULTY RESEARCH PROJECTS AT PREDOMINANTLY UNDERGRADUATE INSTITUTIONS.

THE ENGINEERING RESEARCH CENTER INITIATIVE, FOR EXAMPLE, CALLS FOR THE INVOLVEMENT OF UNDERGRADUATES IN THE PROGRAM AT ALL CENTERS, THUS GIVING FUTURE ENGINEERS EARLY EXPOSURE TO THE RESEARCH ENTERPRISE.

SUPPORT FOR GRADUATE STUDENTS AND POSTDOCTORALS COMES IN LARGE PART FROM THEIR PARTICIPATION IN NSF-SUPPORTED RESEARCH GRANTS. IN 1986 THE NUMBER OF GRADUATE STUDENTS AND POSTDOCS SUPPORTED ON RESEARCH GRANTS IS EXPECTED TO INCREASE 4%, TO A TOTAL OF 14,387.

THE SEE ACTIVITY ALSO PROVIDES GRADUATE RESEARCH FELLOWSHIPS, WHICH WILL CONTINUE AT THE 1985 LEVEL OF $27.3 MILLION. IN 1986, NSF WILL MAKE 560 NEW AWARDS, BRINGING THE TOTAL NUMBER OF GRADUATE FELLOWS SUPPORTED UP TO APPROXIMATELY 1520.

ALSO, THE PRESIDENTIAL YOUNG INVESTIGATOR RESEARCH AWARDS, INITIATED IN FY 1984, WILL PROVIDE RESEARCH SUPPORT FOR THE NATION'S MOST PROMISING YOUNG SCIENCE AND ENGINEERING FACULTY MEMBERS. WITH MATCHING FUNDS AND PARTICIPATION FROM THE INDUSTRIAL SECTOR, THE AWARDS ARE INTENDED TO ENCOURAGE THESE YOUNG PEOPLE TO SELECT AND REMAIN IN ACADEMIC CAREERS, ENSURING THE EXCELLENCE OF THE NATION'S SCIENCE AND ENGINEERING EDUCATION, TRAINING, AND RESEARCH.

BIOTECHNOLOGY

THE UNITED STATES IS CURRENTLY THE WORLD LEADER IN MOST ASPECTS OF BIOTECHNOLOGY. MAINTAINING THAT LEADERSHIP THROUGH FEDERAL, INDUSTRIAL AND ACADEMIC EFFORTS, INDIVIDUALLY AND IN PARTNERSHIP, IS IMPORTANT TO THE FUTURE HEALTH OF THIS COUNTRY IN ECONOMIC GROWTH, NATIONAL SECURITY, QUALITY OF LIFE, AND SCIENTIFIC PROGRESS.

WE CANNOT TAKE THAT LEADERSHIP ROLE FOR GRANTED; WE MUST CONTINUE TO WORK HARD TO MAINTAIN IT.

WHILE MANY FEDERAL AGENCIES - NIH, USDA, DOE, AND DOD -SUPPORT BIOTECHNOLOGY RESEARCH RELATED TO PROBLEM-ORIENTED APPLICATIONS, NSF HAS A UNIQUE ROLE TO PLAY.

WE SUPPORT A WIDE VARIETY OF BASIC RESEARCH ACTIVITIES SUCH AS FUNDAMENTAL GENETICS, CELL PHYSIOLOGY, CELL CULTURE BIOLOGY, NUCLEIC ACID CHEMISTRY AND MICROBIAL ECOLOGY WHICH ARE GENERALLY REGARDED AS BEING ESSENTIAL TO THE FURTHER ADVANCEMENT OF RESEARCH IN BIOTECHNOLOGY. THIS RESEARCH EMBRACES FUNDAMENTAL SCIENTIFIC AND ENGINEERING QUESTIONS.

NSF IS ALSO THE PRIMARY FEDERAL SUPPORTER OF BASIC RESEARCH IN SYSTEMATICS AND ECOLOGY THAT FORM THE SCIENTIFIC BASE NECESSARY TO ASSESS THE POTENTIAL ENVIRONMENTAL IMPACT OF THE VARIOUS PRODUCTS AND BYPRODUCTS OF BIOTECHNOLOGY.

THERE ARE SEVERAL ~~AL~~ AREAS WHERE EXPANDED NSF ACTIVITY IN FY 1986 COULD YIELD PROMISING RESULTS.

- ENHANCED SUPPORT OF KNOWLEDGE-LIMITED AREAS SUCH AS THE CHEMISTRY OF LIFE PROCESSES, BIOCHEMICAL ENGINEERING, PROTOPLAST CULTURE, AND ENZYME ACTIVE SITE COMPUTER MODELING.

- INCREASED SUPPORT FOR TRAINING THAT BRIDGES DISCIPLINES SUCH AS MOLECULAR BIOLOGY AND PLANT BIOLOGY OR ECOLOGY, CHEMISTRY AND BIOCHEMISTRY; AND CHEMICAL ENGINEERING AND BIOLOGY.

ENGINEERING RESEARCH

ENGINEERING IS THE KEY TO CONVERTING SCIENTIFIC PROGRESS AND TECHNOLOGICAL BREAKTHROUGHS INTO USEFUL PRODUCTS AND PROCESSES. WE RECENTLY RESTRUCTURED OUR ENGINEERING PROGRAMS TO FOCUS ON ENGINEERING RESEARCH ISSUES THAT ARE IN PART DRIVEN BY TECHNOLOGICAL NEEDS AS WELL AS OPPORTUNITIES THAT ARE DRIVEN BY NEW SCIENTIFIC DISCOVERIES.

THIS NEW THRUST ALSO RECOGNIZES THE NEED FOR UNIVERSITY AND INDUSTRY ENGINEERS TO COLLABORATE. THE RECENTLY ESTABLISHED ENGINEERING RESEARCH CENTERS (ERCS) PROGRAM WILL EXPAND ENGINEERING RESEARCH AND IS EXPECTED TO FACILITATE CROSS-DISCIPLINARY RESEARCH ACTIVITIES AND TO PROVIDE CROSS-DISCIPLINARY RESEARCH EXPERIENCE FOR UNDERGRADUATE AND GRADUATE STUDENTS. THE CENTERS ARE EXPECTED TO PROVIDE FOR EXCHANGES BETWEEN INDUSTRY AND FACULTY, AND SHOULD DEVELOP FUNDAMENTAL KNOWLEDGE ACROSS A BROAD SPECTRUM OF ENGINEERING THAT WILL ENHANCE THE INTERNATIONAL COMPETITIVENESS OF U.S. INDUSTRY. THE SUBJECT MATTER OF THE CENTERS RANGES FROM MICRO-

ELECTRONICS AND BIOTECHNOLOGY, TO MANUFACTURING RESEARCH. THE LATTER, IN PARTICULAR, REFLECTS RENEWED INTEREST BY UNIVERSITIES IN THIS ECONOMICALLY IMPORTANT ACTIVITY. AFTER PUTTING 142 PROPOSALS THROUGH THE PEER REVIEW PROCESS, THE BOARD RECENTLY SELECTED SIX CENTERS FOR FUNDING.

INDUSTRY PARTICIPATION IS AN IMPORTANT FEATURE OF THE ERCS, AS IT IS WITH THE INDUSTRY/UNIVERSITY COOPERATIVE RESEARCH CENTERS (IUCS). NSF AND INDUSTRY SHARE THE COST OF OPERATING IUCS FOR FIVE YEARS, AFTER WHICH THE CENTER IS TO BE SELF-SUSTAINING.

THE IUCS ARE BEING MANAGED IN THE ENGINEERING DIRECTORATE BECAUSE THEY ARE SIMILAR TO THE ERCS IN THAT THEY ARE PREDOMINATELY ENGAGED IN ENGINEERING RESEARCH. THE IUCS, HOWEVER, ARE MUCH SMALLER IN SIZE AND DO NOT FOCUS ON THE EDUCATION NEEDS OF UNDERGRADUATE AND GRADUATE STUDENTS.

INTERNATIONAL

THE FOUNDATION'S INTERNATIONAL RESEARCH ACTIVITIES ARE BECOMING INCREASINGLY IMPORTANT TO THE OVERALL SUCCESS OF OUR SCIENTIFIC AND ENGINEERING RESEARCH EFFORTS.

BASIC SCIENTIFIC AND ENGINEERING RESEARCH DEALS WITH FUNDAMENTAL QUESTIONS OF OUR UNIVERSE, QUESTIONS THAT TRANSCEND NATIONAL BOUNDARIES. IT IS NO SMALL WONDER, THEN, THAT INTERNATIONAL COOPERATION AND COMMUNICATION ARE EXTREMELY IMPORTANT IN ADVANCING SCIENTIFIC AND ENGINEERING RESEARCH, AND OPTIMIZING ITS RESULTS.

INTERNATIONAL PARTICIPATION PROVIDES ACCESS TO SPECIAL FACILITIES, INSTRUMENTS AND EXPERTISE LOCATED ABROAD; PROVIDES ACCESS TO SITES TO OBSERVE NATURAL AND SOCIAL PHENOMENA; AND ENCOURAGES SHARING THE COSTS OF LARGE RESEARCH INSTALLATIONS. IN ADDITION, COOPERATIVE SCIENTIFIC AND ENGINEERING PROGRAMS OFTEN SERVE TO SUPPORT AND STRENGTHEN U.S. FOREIGN POLICY OBJECTIVES.

ONE OUT OF EVERY FIVE FOUNDATION GRANTS CONTAINS SOME FORM OF INTERNATIONAL ACTIVITY, RANGING FROM TRAVEL FOR MEETINGS HELD ABROAD TO MAJOR GLOBAL PROGRAMS SUCH AS THOSE IN THE ATMOSPHERIC AND OCEAN SCIENCES.

THE NSF HAS FORMAL BILATERAL AGREEMENTS FOR COOPERATIVE RESEARCH WITH SOME 30 COUNTRIES, CUTTING ACROSS A WIDE RANGE OF DISCIPLINES. WE ALSO PROVIDE SUPPORT TO THE NATIONAL ACADEMY OF SCIENCES FOR COOPERATION WITH SISTER ACADEMIES IN CHINA AND EASTERN EUROPE, AND PARTICIPATE IN SUCH ADMINISTRATION INITIATIVES AS THE U.S - INDIA SCIENCE AND TECHNOLOGY AGREEMENT.

FOR THE MOST PART, THE DISCIPLINE-ORIENTED RESEARCH DIRECTORATES PROVIDE THE MAJOR SUPPORT AND DIRECTION FOR INTERNATIONAL ACTIVITIES. THERE ARE TWO MAJOR INTERNATIONAL COOPERATIVE ACTIVITIES -- ANTARCTIC RESEARCH AND OCEAN DRILLING --THAT TOGETHER WITH SOME 700 OTHER PROJECTS PROVIDE $73.0 MILLION FOR RESEARCH WITH INTERNATIONAL IMPLICATIONS.

IT IS IMPORTANT FOR BOTH SCIENTIFIC AND ENGINEERING RESEARCH AND U.S. FOREIGN POLICY OBJECTIVES THAT THESE INTERNATIONAL RESEARCH ACTIVITIES BE CONTINUED.

COMPUTERS

THE COMPUTER AFFECTS THE RESEARCH PROCESS IN A FUNDAMENTAL WAY. MODELLING AND SIMULATION COMPLEMENT EXPERIMENTATION AND THE INSIGHTS GAINED ARE ENHANCED AND COMPRESSED IN TIME.

COMPUTERS AND COMPUTER TECHNOLOGY PROVIDE A UNIQUE CHALLENGE AND OPPORTUNITY TO NSF-SUPPORTED RESEARCH ACTIVITIES.

o AS RESEARCH TOOLS, THEY PROVIDE INCREDIBLE OPPORTUNITIES TO EXPLORE, OBSERVE, AND UNDERSTAND PHENOMENA THROUGH WHICH INVESTIGATORS ARE FINDING EXCITING NEW RESEARCH QUESTIONS TO ANSWER.

o AS RESEARCH DISCIPLINES, COMPUTATIONAL MATHEMATICS, COMPUTER SYSTEMS AND DESIGN, INFORMATION SCIENCE, AND OTHER AREAS HELP ADVANCE THE STATE-OF-THE-ART IN COMPUTER TECHNOLOGY.

WE ARE ENGAGED IN FOUR ACTIVITIES TO ADVANCE RESEARCH ON COMPUTERS AND RESEARCH USING COMPUTERS.

- SUPERCOMPUTER FACILITIES PROVIDE SUPPORT FOR ESTABLISHING AND OPERATING SUPERCOMPUTER CENTERS, WHICH WILL MAKE AVAILABLE TO THE RESEARCH COMMUNITY THE MOST ADVANCED COMPUTING EQUIPMENT. THREE TEMPORARY CENTERS WERE ESTABLISHED IN 1984 TO PROVIDE TIME ON EXISTING COMPUTERS. IN 1985 WE WILL HAVE THREE PERMANENT FACILITIES WITH CLASS VII COMPUTERS, A CENTER USING AN EXPERIMENTAL COMPUTER CONFIGURATION, AND A SUPERCOMPUTER TRANSFERRED FROM THE NASA INVENTORY TO THE FOUNDATION IN LAST YEAR'S APPROPRIATION BILL WILL BE MADE AVAILABLE TO UNIVERSITY RESEARCHERS.

- NETWORKING PROVIDES SUPPORT FOR ESTABLISHING ACCESS BETWEEN SCIENCE AND ENGINEERING RESEARCHERS AND LARGE-SCALE COMPUTING FACILITIES. IT ALSO WILL PROVIDE ADVANCED COMMUNICATION SERVICES ACCESSIBLE TO ALL MEMBERS OF THE SCIENTIFIC COMMUNITY, WHICH IN TURN PROMOTES COLLABORATION, RESOURCE SHARING AND RAPID DISSEMINATION OF RESEARCH RESULTS.

- LOCAL FACILITIES ASSIST IN THE ACQUISITION AND OPERATION OF ESSENTIAL COMPUTING FACILITIES AT THE RESEARCHER'S OFFICE OR LABORATORY. THIS WOULD INCLUDE WORK STATIONS, MINI-COMPUTERS, GRAPHICS FACILITIES, LOCAL AREA NETWORKS, ARRAY PROCESSORS, AND OTHER COMPUTING FACILITIES OR SERVICES NEEDED ON A DAILY BASIS TO CARRY OUT RESEARCH.

- RESEARCH ON COMPUTERS PROVIDES SUPPORT FOR COMPUTATIONAL MATHEMATICS, COMPUTER DESIGN, INFORMATION SCIENCE, MATERIALS RESEARCH, AND OTHER AREAS WHICH HELP ADVANCE THE STATE-OF-THE-ART IN COMPUTER TECHNOLOGY.

THE NSF HAS A UNIQUE -- AND QUITE ESSENTIAL -- ROLE BECAUSE UNLIKE OTHER FEDERAL AGENCIES, IT DOES NOT IMPOSE MISSION CRITERIA IN SELECTION OF THE RESEARCH PROJECTS. MORE IMPORTANTLY, NSF CAN PROVIDE SUPPORT FOR COMPUTER RESEARCH AND COMPUTERS ACROSS A WIDE SPECTRUM OF DISCIPLINES. SUCH SUPPORT PROVIDES TALENT AND KNOWLEDGE THAT MIGHT NOT BE OTHERWISE AVAILABLE, ESPECIALLY IN THE TRAINING OF GRADUATE STUDENTS IN COMPUTER RESEARCH AND ENGINEERING.

INSTRUMENTATION

EARLIER I DISCUSSED THE NEED FOR NEW AND IMPROVED INSTRUMENTS TO KEEP OUR RESEARCH EFFORTS AT THE CUTTING EDGE.

DURING THE LAST SEVERAL YEARS, WE HAVE PLACED STRONG EMPHASIS ON INSTRUMENTATION, TAKING A FLEXIBLE APPROACH THAT IS RESPONSIVE TO THE NEEDS OF THE RESEARCHER AND THE DISCIPLINE. IN FACT, SUPPORT FOR INSTRUMENTATION HAS MORE THAN DOUBLED SINCE 1983 TO $270 MILLION IN 1986. INCLUDED IN THIS TOTAL IS $121 MILLION FOR CAPITAL EQUIPMENT.

EQUIPMENT FOR ALL PHASES OF RESEARCH IS SUPPORTED: INDIVIDUAL RESEARCH PROJECTS; MULTI-USE SPECIAL EQUIPMENT PROGRAMS AND LARGE CENTERS AND FACILITIES; UNIQUE INSTRUMENTS AND FACILITIES; AND COLLEGE SCIENCE INSTRUMENTATION. THE EQUIPMENT MAY RANGE FROM A SMALL INSTRUMENT USED BY A SINGLE RESEARCHER, TO LARGE CAPITAL ITEMS SUCH AS SUPERCOMPUTERS, THE CORNELL ELECTRON STORAGE RING (CESR), THE VERY LONG BASELINE ARRAY, AND OCEAN-GOING SHIPS ACCESSIBLE TO LARGE NUMBERS OF SCIENTISTS AND ENGINEERS.

CONTINENTAL LITHOSPHERE

THE MAJOR FOCUS OF THE FOUNDATION'S EARTH SCIENCES SUBACTIVITY IN FY 1986 IS THE CONTINENTAL LITHOSPHERE, THE RELATIVELY RIGID EXTERIOR LAYER OF THE EARTH WHICH MOVES IN A SERIES OF PLATES OVER THE EARTH'S SURFACE, FORMING THE OCEANS, MOUNTAIN RANGES AND CONFIGURATION OF THE CONTINENTS AS WE KNOW THEM TODAY. THE CONTINENTAL CRUST, GENERATED THROUGH EONS OF PLATE INTERACTIONS, CONTAINS A PARTIAL RECORD OF DEFORMATION AND VOLCANIC EVENTS BILLIONS OF YEARS OLDER THAN ASSOCIATED WITH OCEANIC LITHOSPHERE.

THE CONTINENTAL LITHOSPHERE PROGRAM SEEKS TO UNRAVEL THIS COMPLEX HISTORY. THE PROGRAM HAS DRAWN ON REPORTS OF INTERNATIONAL BODIES, THE NAS/NRC AND AD HOC PANELS INCORPORATING SEVERAL COMPLEMENTARY APPOACHES:

- SEISMIC REFLECTION PROFILING THAT PROVIDES THE HIGHEST RESOLUTION PROFILES OF THE LITHOSPHERE'S UPPER 50 TO 70 KILOMETERS.
- SEISMOGRAPH ARRAYS LINKED TO COMPUTERS THAT PROVIDE HIGH-RESOLUTION IMAGING OF CRUST AND DEEPER PARTS OF THE LITHOSPHERE, AND POSSIBLE MOVEMENTS OF THE LITHOSPHERE AND UNDERLYING MANTLE.
- GEOPHYSICAL SENSING TECHNIQUES THAT REQUIRE CALIBRATION BY DRILLING, FOR MEASUREMENTS THAT CAN BE MADE IN NO OTHER WAY.
- CORE SAMPLING TECHNIQUES FOR ISOTOPIC AND OTHER LABORATORY STUDIES.
- SATELLITE OBSERVATIONS OF CRUSTAL MOTIONS AND SUPPORT OF LABORATORY STUDIES TO AID IN INTERPRETATION OF SEISMIC DATA.

THE AIM OF THE CONTINENTAL LITHOSPHERE PROGRAM IS AN IMPROVED UNDERSTANDING OF THE EARTH'S LITHOSPHERE IN GENERAL, AND OF THE CRUST UNDERLYING NORTH AMERICA SPECIFICALLY, THAT COULD RESULT IN REVOLUTIONARY SCIENTIFIC DISCOVERIES. THESE IN TURN COULD LEAD TO BREAKTHROUGHS IN THE SEARCH FOR POSSIBLE FUTURE NEW ENERGY SOURCES AND MINERAL DEPOSITS, RESPONSIBLE METHODS OF WASTE DISPOSAL, AND ADVANCES IN PREDICTION OF EARTHQUAKES AND VOLCANIC ACTIVITY.

ADVANCES ARE ALSO EXPECTED IN THE UNDERWATER EXPLORATION OF THE LITHOSPHERE; IN PARTICULAR, THROUGH THE OCEAN DRILLING PROGRAM USING THE MODERN, NEWLY-OUTFITTED DRILLSHIP JOIDES RESOLUTION (SEDCO/BP 471) THAT RECENTLY PUT TO SEA FOR SCIENTIFIC DRILLING.

POLAR PROGRAMS

For some time, the Foundation has been closely involved with the unique research opportunities available at the opposite ends of the world. Our focus on these regions continues as programs in the natural sciences respond to basic research questions.

Examples include investigation of the dynamics of the pack ice in the Arctic Ocean, terrestrial biology in the tundra of arctic Alaska, drilling of ice cores in Greenland for studies of climate trends, geophysical studies in the Svalbard group of islands, marine geology and oceanography in the far North Atlantic, and, currently, an assessment of the hugely productive ecosystem of the Bering Sea.

While the Foundation provides only 15 to 20 percent of the federal arctic research support, we have a new coordinating role as a result of the Artic Research and Policy Act of 1984. The Foundation is responsible for the 11-member Interagency Arctic Research Policy Committee, and it provides assistance to the independent, Presidentially-appointed Arctic Research Commission. The new Act directs the development and implementation of national policies and research plans and more extensive coordination of federal agency planning and budgeting for arctic research.

In Antarctica, scientific research continues as the Nation's principal expression of policy and interest within that region, although in recent years, international political and diplomatic gestures have centered on management of the Antarctic, and particularly its natural resources.

In a recent international conference hosted by the National Academy of Sciences near the Beardmore Glacier, various groups from the Antarctic Treaty and other Nations had a frank exchange of views. The past successes of the Antarctic Treaty, and its ability to adapt to changing conditions and new member nations, were recognized clearly. We believe that the Antarctic Treaty should remain as the basis for any management regime for Antarctica.

RESEARCH IN THE LAST YEAR INCLUDED STUDY OF BIOTIC PRODUCTION AT AND NEAR THE EDGE OF ANTARCTIC SEA ICE, WHICH OCCUPIES UP TO 7 PERCENT OF THE WORLD OCEAN. BIOMASS IN THIS MARGINAL ICE ZONE HAS BEEN FOUND TO BE AS DENSE AS REPORTED ANYWHERE, AND THE STUDIES FROM ABOARD AN ICEBREAKER, A RESEARCH SHIP, AND ON THE SEA ICE OF MCMURDO SOUND ARE ENABLING INVESTIGATORS TO UNDERSTAND AND QUANTIFY THIS VERY IMPORTANT COMPONENT OF THE ANTARCTIC MARINE ECOSYSTEM.

IN THE COMING 1985-1986 AUSTRAL SUMMER, APPROXIMATELY 100 RESEARCH PROJECTS WILL BE SUPPORTED IN ASTRONOMY, UPPER ATMOSPHERE PHYSICS, METEOROLOGY, GLACIOLOGY, GEOLOGY AND GEOPHYSICS, THE OCEAN SCIENCES, AND BIOLOGY.

WE WILL REOPEN SIPLE STATION, NEAR THE BASE OF THE ANTARCTIC PENINSULA, FOR A FINAL 2 YEARS OF OPERATION IN SUPPORT OF INVESTIGATIONS OF THE IONOSPHERE AND THE MAGNETOSPHERE.

SIPLE STATION HAS BEEN EXTREMELY PRODUCTIVE SCIENTIFICALLY, AND THE LITERATURE FROM THIS WORK IS AT THE CENTER OF INTELLECTUAL CHANGE IN UPPER ATMOSPHERE PHYSICS. WE WILL CLOSE THE STATION IN 1987 SINCE IT WILL HAVE REACHED THE END OF ITS SAFE OPERATING LIFE.

OTHER IMPROVEMENTS IN ANTARCTIC OPERATIONAL SUPPORT ARE THE INTRODUCTION OF THE ICE-STRENGTHENED RESEARCH SHIP POLAR DUKE, WHICH HAS BEEN CHARTERED, THE INSTALLATION OF SATELLITE COMMUNICATIONS FOR DATA TRANSFER FROM MCMURDO, PALMER, AND SOUTH POLE TO THE UNITED STATES, AND HABITATION IMPROVEMENTS INCLUDING A NEW WATER PLANT AT MCMURDO STATION.

CONCLUSION

MR. CHAIRMAN, THIS IS A TOUGH BUDGET YEAR FOR EVERYBODY. HARD DECISIONS HAD TO BE MADE, AND IN THIS ATMOSPHERE IT IS SOMETIMES DIFFICULT TO FOCUS ON PROGRAMS WITH LONG TERM PAYBACKS; BUT THAT IS OUR OBLIGATION.

THE PRESIDENT HAS MADE HIS DECISIONS, AND THE FOUNDATION HAS FARED WELL. THAT'S IMPORTANT BECAUSE THIS ADMINISTRATION CONTINUES TO BELIEVE, AS I DO, THAT BASIC SCIENTIFIC AND ENGINEERING RESEARCH IS ESSENTIAL FOR CONTINUING ECONOMIC GROWTH, MAINTAINING THE NATIONAL SECURITY, AND IMPROVING OUR QUALITY OF LIFE.

WE TAKE THIS RESPONSIBILITY VERY SERIOUSLY. WE EVALUATED OUR PROGRAMS AND PRIORITIES AND ALSO HAD TO MAKE SOME HARD DECISIONS. WE HAVE FORGED THIS PROCESS INTO A 1986 REQUEST WHICH MAINTAINS THE MOMENTUM IN NEW SCIENTIFIC AND ENGINEERING RESEARCH, BUILDS A STRONG FOUNDATION FOR SCIENCE AND ENGINEERING EDUCATION RESEARCH, AND ACHIEVES AN OPTIMAL BALANCE BETWEEN INVESTIGATOR, GROUP AWARDS, AND LARGE FACILITIES.

THIS BUDGET REQUEST ALONG WITH YOUR CONTINUED SUPPORT SIGNALS STRONG COMMITMENT TO KEEP U.S. SCIENTIFIC AND ENGINEERING RESEARCH AND TECHNOLOGY THE WORLD'S BEST.

I'LL BE HAPPY TO ANSWER ANY QUESTIONS YOU HAVE.

The CHAIRMAN. Did you have any statement you would care to make, Senator Grassley?

Senator GRASSLEY. Yes. I am just going to put my statement in the record, but I do have a couple of questions.

The CHAIRMAN. That will be fine.

Senator GRASSLEY. Thank you, Mr. Chairman.

First of all, I would like to compliment you on your testimony. I am glad I was here to hear most of it and appreciate in some areas some new responsibilities you have that we mandated that you haven't had an opportunity yet to carry out to the fullest extent, and that is all understandable.

In regard to one of those, as you have already said, the math/science bill was not passed by Congress until after the 1985 appropriations were already made to the NSF. If you could, I would like to have you just give me a brief summary of the activities authorized by that bill that you had an opportunity to implement

Mr. BLOCH. Well, as I said in my statement, we have implemented a large number of the provisions of the act. We have, for instance, emphasized the partnerships among universities, local and State governments, industry and the Federal Government—not in quite the same and precise way as the act prescribes, but I think in the total context of the way we are administering programs in the National Science Foundation, I think we have done that to a considerable extent.

The stress on improving cooperation between departments of mathematics and science and departments of education is another point that we are stressing, and the emphasis on providing services to the segments of the population which are underrepresented today, I think we have done that to a considerable extent.

So I think in spirit, if not exactly in the law, in the precise definition of the law as it was expressed in the authorization bill last year, I think we have implemented all of these things that were on your mind and that are also on our mind.

Senator GRASSLEY. Well, how much will your agency spend next year to improve equipment used for research?

Mr. BLOCH. Used for research—do you mean in high schools and so forth?

Senator GRASSLEY. Yes.

Mr. BLOCH. Well, we have earmarked for this year, 1985, and also for 1986, approximately $5 million, which is a matching kind of a fund. So probably what we can hope for is that we see a total investment of about $10 million after the matching has taken place.

And we expect to see the same thing next year; as I mentioned in my statement, we are even considering upping the matching provisions somewhat over this year, but we are still discussing that.

Senator GRASSLEY. Have tax deductions given to industry under the current law encouraged donation of equipment used for research and research training?

Mr. BLOCH. In general, yes. Let me be specific. The R&D tax credit bill, which is up for renewal this year in Congress, I think had a profound influence on industry spending in terms of research and development, not only in their own organizations, but also in universities. I think the equipment donations that have been forthcoming over the last couple of years are a result of, or have been spurred on—I am not saying that it would not have happened without that, but they sure have increased and been spurred on by the fact of this R&D tax credit. Yes, I believe this strongly.

Senator GRASSLEY. You would advocate, then, the renewal of those tax credits?

Mr. BLOCH. Not only would I advocate the renewal; I would also suggest that as far as industry-sponsored university research is concerned, you might want to strengthen that bill and give added emphasis for industry to spend money, research dollars, in universities and also spend research dollars for equipment, or spend dollars for equipment. But I think the bill could be strengthened in that regard.

Senator GRASSLEY. Over the last decade or so, there were a lot of research grants that have been made fun of by magazines like National Enquirer and all that. What have you done, if anything, that you felt needed to be done to ensure the legitimacy of research activities in the so-called soft sciences so that this sort of disparaging remarks would not be detrimental to the overall efforts of research that we would all respect and would want to promote?

Mr. BLOCH. Well, let me say two things about that first of all. The programs for which the National Science Foundation is responsible—and it includes some programs in what you have called the soft sciences, like the behavioral and social sciences in particular—we are going through these programs in the same excruciating detail, in peer-reviewing these programs, making sure that they meet the requirements and the needs, number one, and also that they stand the test of excellence, like any other programs in the Foundation. So they are being treated the same as mathematics or physics or engineering kinds of programs.

So, within the Foundation, we are doing everything to make sure that the excellence of these programs and also their relationship to the need is being looked at and being considered, in the same way as any other programs.

Second, in the R&D tax credit extension, my understanding is—and I am not an expert in the area—that there are some provisions in the proposed new bill that would essentially limit and make sure that some of the concerns that you have about it are not present, so that we are essentially strengthening the definition of research to mean exactly what research should mean; namely, the furthering of understanding and knowledge in science and engineering.

Senator GRASSLEY. I thank you.

Mr. Chairman, I believe those are all the questions I have at this time.

The CHAIRMAN. Thank you.

Senator Kennedy, let me turn to you, and then I will have some questions.

Senator KENNEDY. Thank you, Mr. Chairman, and I would like to have my opening statement put in the record.

The CHAIRMAN. Without objection.

Senator KENNEDY. And I would extend a warm word of welcome to our two witnesses here this morning.

Dr. Bloch, have you addressed the implications of the failure to get an NSF authorization through the Congress? What impact has there been in terms of the functioning of the Agency. I know this is a matter of enormous distress to the chairman, and it is to me. We have approved NSF legislation over a long period of years, but are unable to get this legislation passed because we are caught in the middle of a dispute with the Commerce Committee. It just seems to me that this is an issue that ought to be resolved.

Would you comment about what the failure of resolving this issue.

Mr. Bloch. Yes, Senator, I would be glad to do that.

First of all, let me say that the increase this year is approximately $60 million. So you might say $60 million on $1.5 billion is not a very big percentage. And, while that is true, let me just make sure that you understand, which I know you do, that these $60 million would really help us greatly to continue initiatives and to put initiatives that are just emerging in the Foundation, that have just started in the Foundation, and put them on a sound kind of level. So those additional dollars are very important to us. It would have ramifications across most of the Foundation's programs—and let me give you some very specific examples. Let me say first one thing. When we signed the program, we gave top priority to people, people aspects; namely, the research that individuals are doing. We put second priorities on instrumentation and facilities in place. And we would have to essentially reverse this priority as we back out the $60 million. So it would essentially hit very hard the instrumentation and the facilities area, and this could mean a curtailment of the Cornell Storage Ring which is in the program today; the Wisconsin Synchotron, at BLBA, and the Engineering Research Centers and Super-Computer Centers. So a big portion of the dollars, we would take out of these programs.

But then, in addition to that, we would have to take some project support away of about $17 million, which would essentially reduce the increases that advanced materials, biotechnology, Continental Lithosphere, math personnel, and so forth, and social and economic sciences have seen in this particular budget. They would have to be reduced and curtailed to a significant amount.

So, first we would try to hit instrumentation and facilities, but that will not quite get us there. We would have to essentially curtail the project support in these very important areas.

Senator Kennedy. I welcome your answer. We hear a great deal of debate and discussion about our economic condition, our balance of payments difficulties and our failure to move in area of productivity. There is also an increasing recognition of the interdependence U.S. economy and the world economy.

One of the things that I think is absolutely essential is investing sufficiently to be competitive both today and in the future. And it seems to me the areas addressed by this legislation—the engineering research centers, the supercomputing, and biotechnology—are absolutely essential if we are going to maintain an edge over the period of the future.

It seems to me we want budget cuts that are going to be fair, but we also want investment in terms of our future so that we can be competitive. And I think the NSF is on the cutting edge of these issues.

Let me ask you about the science education programs. Can you tell us what the NSF is doing in the science education area and what we can expect over the period of this next year?

Mr. BLOCH. As I mentioned in my statement before, Senator——

Senator KENNEDY. If you have covered it, then be very brief.

Mr. BLOCH. Let me just be very brief. We are really concentrating on the pre-college area, because we think there is a need in that particular area specifically that the Foundation can address and can address very well. So that is our concentration, and that will be our concentration over the next few years. And we are trying to build a cohesive program in that area so that it can stand the test of reason and really, essentially, leverage the funds that we are putting in there.

In addition to that one, we have continued and are increasing somewhat our graduate fellowship programs, and that is very important.

And the third area, which we already touched on a minute ago, is the instrumentation and program itself.

So those are the three main programs essentially that we have earmarked.

Senator KENNEDY. The program that I have been very interested in over the years is the women and minorities program. I think we forego a great deal of potential when we fail to tap the abilities of a number of those in our society who are effectively denied the opportunity of having a career in science and engineering research. I would be interested in hearing of the progress of "mainstreaming" those programs for woman and minorities. What are the implications of mainstreaming those programs in terms of the goals which we have established to open up areas of science and research to women and minorities?

Mr. BLOCH. Well, let me discuss that. As you mention, we are trying to mainstream the programs in this particular area for primarily one reason—if we keep it a sheltered kind of a program, it will always have very limited kinds of capabilities. By mainstreaming it essentially, we hope that the rest of the Foundation, and we are sure that the rest of the Foundation understands the need for it, number one, and participates in it in a considerable kind of way.

Senator KENNEDY. What is your professional evaluation? Do you think that it works?

Mr. BLOCH. I think that will work very well, yes. I think it was important that we started these programs as sheltered kinds of programs to get them off the ground. But I think that now that they are in existence, and people know what these programs are all about, mainstreaming them now I think is the right approach.

Senator KENNEDY. OK. Could you monitor that? I would like to keep in touch with it closely.

Mr. BLOCH. Absolutely. We are monitoring that—in fact, we have provisions in the Foundation that no matter where this money is being spent or where the grants are coming from, that we are essentially centralizing the knowledge of these and can talk to you about it in specific terms.

Senator **Kennedy**. Do you have a management information system to monitor this?

Mr. **Bloch**. Yes, we have a management information system which needs a lot of work. It is not as good as it should be, and we are working on that one very deliberately, to make sure that we understand and that we have available all the data that we need to make these programs a success, and also that we can judge how successful the programs are. That is one of my high priorities.

Senator **Kennedy**. Fine. On another matter, I recently visited one very important center, Oceanographic Center, up at Woods Hole, Massachusetts. I thought that the directors up there made a very compelling case for discretionary funding for innovative research. And I have mentioned this to our chairman. I am a strong believer in peer review and other kinds of reviews, but I do think that this is something that is necessary. In my discussions with the people at Woods Hole, they felt that the possibilities for additional kinds of progress in science research would be enhanced if there were some degree of flexibility, in the funding of innovative projects. I would be interested in your own evaluation of this.

Mr. **Bloch**. Well, I know of your discussions with the center, and I had some discussions afterward with the director there. From his viewpoint, I can understand what he is saying. And by the way, he has some discretionary funds, in terms of any manager who has a big program like that can find some discretionary dollars here and there. And we are not looking at him that closely so that he does not have some freedom.

But let me make one particular point. Even within the Foundation, we have made that particular point to our program officers, that they should essentially make sure that they are using some of their own judgment and discretion, and not putting a dollar value on it, essentially, for programs that are risky, that are not necessarly completely peer-reviewed in that sense, that have been peer-reviewed, but where some judgment is still there, and made some investment that for the future might really pan out and is very important to us, and not just be looking at what we have been funding in the past, to make that a guide to the future.

So I think we are stressing that point. I would not like to see some dollars set aside precisely, because I think that gets us into other problems.

Senator **Kennedy**. That is a very constructive and positive statement—but I suppose the question here is whether it is interpreted by the program managers—to give them sufficient flexibility or whether they feel that they are going to get caught in some kind of a crossfire. I think the record would reflect that. I do not pretend to know what happens in other areas, or whether they have got some degree of anxiety because of the restrictions in terms of the review of their budget and the accountability. I do not know what you could tell us about that.

Mr. **Bloch**. Well, that is always a problem, essentially, to make sure that program officers understand that this is a permissible kind of activity within reason. Now, we are stressing that, and we are highlighting, in fact, that many of the activities that were funded in that particular way and that turned out to be very good and very beneficial. So we are trying to make that clear.

Senator KENNEDY. All right. Moving rapidly through some of these other subjects, the Ethics and Values in Science Program has been something we have been very interested in. I would just like to know what the justification is for eliminating that program in the 1986 budget.

Mr. BLOCH. Let me speak to that particular point. First of all, as I mentioned before, we had to review all the base programs to make sure that we had the right priorities, even in the programs that have been funded for a long time.

This particular program, in its form as it was administered, has been in existence since 1976, and it has done a lot of good work. It has put a lot of emphasis on areas that probably otherwise would not have been highlighted. But I believe very strongly that this particular program can stand on its own feet, and together with all of the other programs in the Foundation. For that reason, we eliminated the program, or the proposal is to eliminate the program, as a sheltered kind of a program. And we are asking that the people who have been working in this particular area, who are doing research in this particular area, avail themselves of the other programs within the Foundation. We are going to come out with a program solicitation on it, but they will be essentially administered by the other directorates, which have essentially the overall responsibility for many of these issues.

Let me just make a couple of points. If you look over the last 50 funding decisions in these particular programs, a large number of those funding decisions had to do with programs that were either risk analysis, which we have a program for in the Foundation, or they were essentially related to ethics and value in the biological sciences and the biological technology, where we have a whole directorate, essentially, that is concerned with the overall biotechnology problem. And therefore, this particular program, or the people that are working in these areas, can apply to, for instance, the biological and behavioral sciences directorate for funding for their own programs.

Also, if you look at the programs that we funded over the last few years, there were a number of them in there which really did not fit in with the National Science Foundation's primary and explicit kind of a mission. A lot of them had to do with essentially medical kinds of research questions for which the NIH, for instance, is a much better agency to judge it.

So, for all of these reasons—namely; mainstreaming this particular program like we are doing in some of the other areas; making sure that the directorates themselves are involved in the decisions where that directorate has a main responsibility—I felt it wise not to continue this program in its stand-alone and sheltered kind of form.

Senator KENNEDY. Well, what kind of assurance can you give us that this function is going to be retained?

Mr. BLOCH. Well, the assurance I can give you on that one is the same as on the minority programs that we discussed before; that ethics and value in science and technology as a subject matter will be dealt with throughout the Foundation, and we will essentially overview that from a staff viewpoint in the same way as the other programs. We are going to make sure that the $1 million is being spent on it, and a floor of $1 million is being spent on it, and that we are essentially understanding what is being spent and how it is being spent and for what kinds of programs it is being spent. So we are treating it the same way as the minority programs we just discussed.

Senator KENNEDY. Well, we will watch that very closely. I have a very strong commitment in this area. We have followed it. The amendments of 1976 were the amendments that I proposed. We have seen over the period of the past where governmental agencies have been blind to these kinds of considerations, including HEW, with the syphilitic study in terms of many American individuals; the use of depoprovera, sterilization, use of depoprovera in women's institutions in some States—those were health-related issues. HEW then was absolutely blind to these questions.

And I think there is one question with regard to the primary agencies, but I think having this program in the areas of science is enormously important if we are going to ensure that science is going to be responsive to some very important issues on ethics.

In my own State, in Cambridge, MA, when we were having DNA research done up there, we went through enormous confusion and emotion within the community. We saw there some important efforts in areas of science and science research that were delayed or deferred.

And I think being able to show that we are on the cutting edge of research, and that ethics and values issues are being considered as the process moves forward, can be enormously valuable and helpful in terms of seeing this agency achieve, or continue to achieve, the kind of excellence that it has in the past.

So I just want to indicate that we certainly want to cooperate in every way to be able to ensure that that function is carried through, but I also want to indicate, at least, a very strong and continuing commitment to this program and that we will watch this issue very carefully.

Mr. Chairman, I have been taking much time, and I see there are other members here. I would like to submit some questions with regard to supercomputers and other areas. With regard to supercomputers, I think this is a matter of enormous importance in terms of the competitiveness, and I am very hopeful that we will maintain a continued emphasis on that. I think the agency has done very well in its commitment to this area, and I highly applaud that. I have some other areas of interests, but I have taken a good deal of time at this point, and I would like to submit those questions.

I will try and remain during the course of the hearing, and if I get another chance, I will come back for another round, but if I do not, I would like to be able to submit those questions.

[Response of Mr. Bloch to questions submitted by Senator Kennedy follow:]

NATIONAL SCIENCE FOUNDATION
WASHINGTON D.C. 20550

May 21, 1985

nsf

OFFICE OF THE
DIRECTOR

Honorable Orrin Hatch
Chairman
Committee on Labor and Human Resources
United States Senate
Washington, D.C. 20510

Dear Mr. Chairman:

Enclosed is supplementary information for the hearing record requested by Senator Edward M. Kennedy following the April 30 Labor and Human Resources Committee hearing on the National Science Foundation's FY 1986 Budget Request.

Sincerely yours,

Erich Bloch
Director

Enclosure

Copy Furnished: Honorable Edward M. Kennedy

INTERNATIONAL SCIENCE

The National Science Board is to be commended for its report which recommended a number of roles and responsibilities for NSF in the area of international cooperation in science and technology. I understand that the Director has convened a task force to develop a strategy for NSF in this area and it is headed by former NSF director, Guy Stever.

Question: What is the status of the task force's recommendations?

Answer: The Task Force on NSF International Strategy and Programs has made several recommendations with implications for the way NSF manages its international activities. NSF staff and the National Science Board are currently reviewing these recommendations and their implications for future directions of NSF's role in international science activities.

Question: What role do you see for NSF in this particularly critical area?

Answer: NSF will continue to play a strong role in the area of international science and engineering in cooperation with the Department of State and under the guidance of the Office of Science and Technology Policy. The question of whether or not we will assume an expanded role in the future is now under consideration.

ENGINEERING CENTERS

NSF has recently announced its first six engineering centers. I am pleased that one is in biotechnology process engineering at MIT and that another one will involve collaboration between Harvard and the University of Maryland for a Center on Systems Research and Research in Robotics, Computer-Aided Engineering, and Artificial Intelligence.

Question: What are your long-range plans for these centers?

Answer: The goal of the Engineering Research Centers program (ERCs) is to develop fundamental knowledge in engineering fields that will enhance the international competitiveness of U.S. industry and prepare engineers to contribute through better engineering practice. Engineering education and research are key elements in improving U.S. industrial productivity, and must be firmly linked in the centers. The Foundation plans to support these centers for a minimum of five years to provide cross-disciplinary research opportunities for faculty and students, to provide a base of fundamental knowledge that can contribute to the solution of important national problems, and to provide engineering graduates with the diversity and quality of education needed by U.S. industry.

The amount and duration of support to these centers will depend upon the availability of funds to the ERC program and the success of the centers in meeting their objectives. Each center will receive an initial budget to support start-up. Once fully developed, it is anticipated that a center's average annual budget for salaries, operating costs, equipment, and supplies would normally be expected to range between $2.5 - $5 million. It is expected that these funds will be provided by a combination of NSF, industrial, other Federal agency, State, and university funds.

NSF's initial awards will provide funds to the ERCs for the first year start-up costs, and commitments are made to the ERCs for five years of NSF support. However, each ERC will be evaluated during the third year to determine if it is meeting its goals and objectives. This review will be used to determine whether NSF will continue to support the center fully for the remaining two years or provide decreased funding to terminate the ERC at the end of the five-year period. It is anticipated that successful centers will be funded beyond the initial five-year period, subject to satisfactory peer review and availability of funds.

Question: How many centers do you hope to start over the life of the program?

Answer: The goal is to establish a minimum of 25 centers in the near term of the program. This goal was drawn from a recommendation to NSF by the National Academy of Engineering. The Academy of Engineering played an instrumental role in the creation and development of the ERC program and recommended to NSF that a target of 25 centers be established.

Once these 25 ERCs are established, the NSF will assess the need for more centers, given the range of research topics being addressed, the degree of industrial support, the Federal/NSF budget situation, the geographic distribution of the ERCs, and the impact on engineering education achievable with the first 25 centers.

RESEARCH FACILITIES

There is a growing concern in some quarters that our academic research facilities are deteriorating at an alarming rate.

Question: How widespread do you feel this concern is?

Answer: Widespread concern exists throughout the academic community about the inadequacy and obsolescence of research facilities and equipment. In 1983, NSF conducted a national survey of academic research instruments and instrumentation needs. Ninety percent of the department heads surveyed reported that, as a result of the lack of needed equipment, there were important subject areas in which their research personnel could not conduct critical experiments. This level of concern was found in all fields and subfields of science and engineering and in all types of universities studied.

Question: How do our university laboratories compare to those in industry and to those in other countries, specifically Japan and West Germany?

Answer: Most university laboratories fare poorly in comparison to the best industrial laboratories. The equipment being used in many of the Nation's top-rated universities has a median age about twice that of the instrumentation available to leading industrial laboratories. To compensate for inadequate support facilities, many university researchers and their students are sometimes forced to divert excessive time from research to perform necessary repairs and maintenance tasks normally carried out by technical staffs in industrial laboratories.

Extensive field by field data is not available that allows broad comparisons of foreign facilities with those in the U. S. However, there are indications that some research facilities in Japan and Western Europe are better equipped than American laboratories. The Japanese government subsidizes modern high quality facilities through productive collaborations between university and industry research laboratories. Also, some of the Max Planck Institutes of West Germany are reported to have research facilities superior to those of the leading science and engineering departments in American universities.

Question: Can you see NSF expanding its role in support of equipment and instrumentation?

Answer: Yes, between FY1983 and FY1985, NSF support for facilities, equipment, and instrumentation at universities and national centers increased from $120 million to $239 million or by 99 percent. This trend is continued in the FY1986 NSF Budget Request, with an increase of $32.7 million above the FY1985 level for high priority equipment and instrumentation.

In addition to its ongoing efforts, the Foundation has undertaken several initiatives that will help to improve the availability of state-of-the-art equipment and instrumentation at the Nation's universities. These initiatives include: The Engineering Research Centers, which are designed to develop fundamental knowledge in engineering that will enhance the international competitiveness of U.S. industry; Advanced Scientific Computing, which will provide opportunities for access to advanced computational facilities by all segments of the science and engineering research community; and Biotechnology, which involves research across several areas, including biology, chemistry, and engineering.

WOMEN AND MINORITIES

The budget proposes to "mainstream" the Minority Research Initiation program and the Research Opportunities for Women program into the budgets of the Research Directorates. This proposal is of concern to me because it could result in a loss of focus that these programs currently achieve as line item programs.

Question: Your predecessor, Dr. Edward Knapp, began the process of mainstreaming many of the NSF programs in this area. What have been the results of that initiative?

Answer: Dr. Knapp's initiative has resulted in closer coordination between the Scientific, Technological, and International Affairs (STIA) Directorate and the disciplinary research directorates in the management of special programs focused on women and minority scientists and engineers. Under this initiative, although funding for Minority Research Initiation (MRI), Research Improvement in Minority Institutions (RIMI), Visiting Professorships for Women (VPW) and Research Opportunities for Women (ROW) was included under the STIA Directorate, very close interaction has been maintained between STIA and the disciplinary research directorates in the peer review and monitoring of projects.

Another positive result of the mainstreaming emphasis has been an increase in the level of outreach activity performed by program officers throughout the Foundation. This occurs through site visits, attendance at professional meetings, special outreach seminars, and improvements in our general dissemination of information. We intend to continue to strengthen this mechanism.

In FY1986, funding for MRI and ROW has been included entirely within the disciplinary research directorates. The FY1986 budget requests for these programs are included as "non-add" line items under the STIA Research Initiation and Improvement subactivity. However, the budgeted amounts shown, $2.5 million for MRI and $1.0 million for ROW, are to be considered as floors rather than ceilings. Also, special separately identified program announcements will continue to be issued for both of these programs, and program managers in STIA will continue their monitoring efforts. In this way, we intend to enhance the visibility of these programs throughout the Foundation, facilitate the transition of researchers from targeted support to mainstream support, and generally increase the representation of women, minorities, and disabled scientists and engineers in all of NSF's activities.

Question: With respect to your management information system to more accurately measure the progress of women and minority participation, when can the committee have a status report that presents baseline data on foundation-wide support for such groups as women and minorities.

Answer: The Foundation is now in the process of developing plans to obtain better data on the participation of women and minorities in all of its activities. This includes participation as grantees or principal investigators, Presidential Young Investigators, proposal reviewers, members of advisory committees, and rotators, among others. We are presently able to characterize the participation of women in our programs and as reviewers with high reliability. We are in the process of putting in place improvements that will allow us to achieve similar levels of information with regard to minorities and disabled persons. The voluntary submission rate of this information continues to improve (over 50% now for new proposals), and we are putting in place several procedures to raise this rate further. These include redesign of forms, and provisions of information on why the data is needed and how it could be used.

With the modest improvements in place in FY1985 we will see significant gains in both the amount and quality of information on women, minorities, and disabled in our programs. We plan full implementation of the additional measures in FY1986.

Question: I wonder whether "mainstreaming" will affect NSF plans to enhance these programs. For instance, the NSF "Long-Range Planning Document for Fiscal Years 1986 to 1990" indicates that the research opportunities for women will be enhanced from $1 million to $7.5 million by 1990. Will mainstreaming affect this?

Answer: We anticipate that mainstreaming will have a positive effect on the overall future funding for research opportunities for women. Funding floors will be maintained for this effort in our long-range plans, and mechanisms are now being considered to enhance its visibility within the scientific community by involving a broader group of NSF personnel in its oversight.

Question: Will a budget freeze affect the current programs to promote access of women and minorities in science and engineering fields?

Answer: The Foundation currently has no plans to reduce targeted programs for women and minorities. However, general reductions may affect the rate at which increased participation by women, minorities, and disabled scientists in non-targeted activities can occur.

The Chairman. Without objection, we will keep the record open until 6 o'clock today for additional questions.

Senator Kennedy. Mr. Chairman, could I include a statement by Senator Dodd?

The Chairman. Without objection, we will place that at the appropriate place in the record.

Senator Kennedy. Thank you.

The Chairman. I have not had the opportunity to ask any questions myself, yet, because I turned to Senator Grassley and then to Senator Kennedy, so let me just ask a few, and then I will turn to Senator Pell.

As you know, most of the members of this committee, including myself, were actively engaged and involved in the development and the passage of Public Law 98-377, the Education for Economic Security Act. I am sure you can appreciate the effort devoted to hearings, markups, and negotiations on this measure, which we considered would be of significant help in the drive to improve the status of math and science education in our country.

I understand that the Foundation feels that its appropriation for science and engineering education is predicated on the proposals put forth by the President in 1983, and not on the legislation we enacted last year. But I am disappointed that our work in the Congress, because of its timing relative to the appropriations process, does not seem to matter to the National Science Foundation.

Now, other than an endorsement of several programs you would have run anyway, what is there about the NSF portion of the Education for Economic Security Act that had any influence on the current implementation of your science and engineering education program?

Mr. Bloch. Well, I think there are a great number of things that are in that act that we have carried forward, as I said before, in spirit as well as in detail. As I mentioned, the encouraging of cooperation between universities and education agencies, encouraging cooperation between the Education Department and math and science departments, supporting of partnerships between the States and industry and the Federal Government—I think we are carrying that one forward, we are asking for that, but not in a very precise kind of way, in a percentage kind of way—encouraging activities toward groups which are underrepresented; we are stressing that particular point in our solicitations.

So there are a great number of things which we are essentially carrying over from that authorization bill, and the provisions in the bill, and essentially implementing in our present kind of programs. There are a large number of items that are in that particular area that we are carrying forward.

What we are not doing, and for which we have no appropriation, is essentially requiring joint submissions of proposals, for instance, and State approval of proposals, and precise geographic distributions, essentially, which that act also requires, and very rigid cost-sharing kinds of requirements. It is those provisions which we felt were too curtailing to the National Science Foundation, number one; it would have taken us a long time to get these implemented and started, and we want to work, and we have had discussions with your staff in that regard to make sure that your staff understands what our problems are with some of these very precise definitions and restrictions as the act imposes on us.

The CHAIRMAN. Now, I anticipate that the committee will reauthorize the math and science program, and I want to personally work with you during this process, and I hope we can avoid many of the misunderstandings that have plagued us recently.

On behalf of the committee, I would be happy to entertain your recommendations concerning reauthorization of this measure at any time that you care to make those recommendations.

Do you have any suggestions you would care to make at this point with regard to that reauthorization?

Mr. BLOCH. No, but I would stress very generally that we would be very glad to work with you and your staff in that regard, and I have expressed this personally to your staff myself. We would be glad to sit down and go over word for word and provision for provision so that you understand where we are coming from, and we understand where you are coming from, and hopefully we will meet somewhere in the middle.

The CHAIRMAN. We appreciate that.

The Department of Energy has been considering a major project to build a superconductor, supercollider. Now, as a scientist yourself, and as a representative of the entire scientific community, can you explain what benefits there would be from such a facility within the United States and what would be its significance to scientific research?

Mr. BLOCH. I would be glad to comment on it. I know you realize that the National Science Foundation is really not concerned with that particular area. But from my own viewpoint, I would like to express my views on it.

It has a high priority, it is a high priority of the administration. It could open up, just like the other machines that were constructed over the last 30 years, whole new areas of particle physics research, which is very important. It would definitely be a boost to our international image because as you know, there is a tight race on in this particular area, and particularly between us and Europe, and maybe even Japan, in the future, in this very important kind of an area.

I think it is also important for our young people who are going into science and engineering that they are assured that there is a continued effort and a continued opportunity in these very important and very demanding kinds of areas, because essentially that is how you attract the people to science and engineering. So it goes beyond just particle physics, essentially. I think it permeates the whole science and engineering research area.

So I very much support it. It is a very costly kind of a program, as you realize very well, but I think somewhere and somehow, we have to find a way of keeping ourselves ahead of our competition. Competition not only exists in the commercial market; it also exists in the research areas, and we have seen that over the last few years in particular. So I would certainly support it.

Maybe Dr. Schmitt would like to comment on the same point.

Dr. SCHMITT. Well, I can only echo what Mr. Bloch has said, that in terms of frontiers of science, elementary particles have been always one of the pioneering areas of science where new fundamental knowledge has been uncovered, and although I am personally not an expert in this field, the community which does know that field very well and works in it considers this to be the next step in probing into the frontiers of science.

So, in terms of scientific importance, I think it is extremely high.

The CHAIRMAN. Thank you. I may submit further questions in writing to you.

Let us turn to Senator Pell at this time.

Senator PELL. Thank you very much, Mr. Chairman.

Welcome, Mr. Bloch, Dr. Schmitt.

As you know, Mr. Bloch, I have been interested for some time in the National Science Foundation's support for ocean sciences. I was wondering in this regard if you could bring me up-to-date on the status of the oceanographic vessel *Endeavor* which has been under charter to the University of Rhode Island. What level of support is NSF allocating to the research fleet, and is there an effort being made to increase this to keep up with inflation?

Mr. BLOCH. Well, I can only comment on the total oceanography program that we have in place. I will be glad to supply to you afterward specifics on your question.

Senator PELL. I think I have the whole program right here. This is the item where you have ocean science research to support oceanographic facilities and ocean building programs, with a total increase of $4.9 million for the year.

Mr. BLOCH. Right.

Senator PELL. But you do not know how that breaks down between the individual vessels?

Mr. BLOCH. No, I do not know how it breaks down, but we will be glad to supply that for you.

Senator KENNEDY. Could you supply it for me, too?

Mr. BLOCH. Yes, I would be glad to.

[Information supplied for the record follows:]

NSF SUPPORT FOR THE ACADEMIC RESEARCH FLEET

The National Science Foundation provides support to the major oceanographic institutions for the vessels within the academic research fleet on a level-of-effort basis rather than purchasing individual ship days. Thus, the following support levels are grouped by institution rather than by ship:

INSTITUTION	VESSEL(S)	1985 SUPPORT
University of Alaska	ALPHA HELIX	$1,447,653
UC-Scripps Institution of Oceanography	MELVILLE WASHINGTON NEW HORIZON R.G.SPROUL	$4,551,749
Columbia University	CONRAD	$2,301,226
University of Delaware	CAPE HENLOPEN	$ 542,800
Duke University	CAPE HATTERAS	$1,026,089
University of Hawaii	MOANA WAVE	$ 750,000
Johns Hopkins University	WARFIELD	$ 505,632
University of Miami	ISELIN CAPE FLORIDA CALANUS	$1,000,000
University of Michigan	LAURENTIAN	$ 125,565
Moss Landing Marine Lab	CAYUSE	$ 340,158
Oregon State University	WECOMA	$1,300,000
University of Rhode Island	ENDEAVOR	$1,478,264
Skidaway Institute of Oceanography	BLUE FIN	$ 88,831
University of Southern California	VELERO IV	$ 364,500
University of Texas	FRED MOORE	$ 200,000
Texas A&M	GYRE	$ 942,000
University of Washington	THOMPSON BARNES	$2,456,658
Woods Hole Oceanographic Institution	ATLANTIS II KNORR OCEANUS	$4,750,000

UNIVERSITY OF RHODE ISLAND & OCEAN DRILLING PROGRAM

The University of Rhode Island (URI) is actively involved in the NSF Ocean Drilling Program (ODP). The general contractor for the overall management of the ODP is Joint Oceanographic Institutions, Inc., (JOI), a consortium of major U.S. oceanographic institutions, including URI. The scientific planning for ocean drilling is carried out by an international organization called JOIDES--the Joint Oceanographic Institutions for Deep Earth Sampling. The JOIDES Office, which rotates between member institutions every two years, is beginning its second year at URI. In addition to providing the non-salaried JOIDES Executive Committee Chairman, Dr. John Knauss, the University also hosts the JOIDES Planning Committee Office and its Chairman, Dr. Roger Larson. The budget for this office is $233,000 annually and supports the full and part time efforts of four professionals. In addition, Dr. Michael Bender at URI was awarded a grant of $53,000 for synthesis work on deep sea drilling data on carbonate structures.

Mr. BLOCH. But let me just stress one particular point. We have very active programs in ocean drilling, which is really an international program. There are many countries that have shown interest in it; some of them have signed up, like Canada and France, to be very specific. Others, like England, for instance, have it under advisement, and also Australia has it under advisement, and some of the smaller countries in Europe as a joint kind of an effort among themselves.

We just fitted up a new ship, which is just starting its first voyage, and I think that particular ship, which I visited a few weeks ago, has really a remarkable set of new technology that will allow us to do things that we could not possibly do before in this very important field of ocean drilling. It is just getting under way, and I think over the years, we will see a very remarkable kind of an output from this particular effort.

So the point I want to stress is that it is an international program; it is not just a national program, and the collaboration with the other nations, I think, is very important.

Senator PELL. What is the name of the vessel, again?

Mr. BLOCH. It is the *Joides Resolution.*

It is a chartered ship. We are not owning it. It is being operated by a division of Schlomberger.

Senator PELL. And is there a component part of this program that is being handled by the University of Rhode Island?

Mr. BLOCH. Well, I think the University of Rhode Island is involved in it, but I am not absolutely sure to what extent and so forth, but we will provide you with that information.

Senator PELL. Thank you very much indeed.

Another area of general interest to me is the Federal support of our Nation's museums, and in this regard, art and history museums have been able to go to the arts and humanities endowments. But science museums, zoos, aquaria, botanical gardens, have not had such access to Government funds. I was wondering if the NSF might be an appropriate source of support.

What would be your reaction, Mr. Bloch, to the idea of the NSF being of help to the scientific museums?

Mr. BLOCH. Well, let me say one thing in general. This whole area of informal education is very important to us. We have a number of programs in that area, not necessarily with regard to museums or botanical gardens and so forth. But every once in a while, we are getting submissions in that particular area, and we are always looking at it to see if it makes sense for us to fund something like that.

I do not know exactly how much of that we have funded over the years, but I would be glad to take a look at it. I am sure it is not a very big amount. And I think again, it has to do with priorities. If we have unlimited budgets, that is one thing, but we do not have, so essentially we have to put our priorities where we can see that we get the most leverage, and we really have to concentrate it very much in this informal education on essentially television programs and things like that, that reach a very broad area. We have focused primarily on that rather than museums.

So I would think it has to do with priorities.

Senator **Pell**. Thank you. Let me return for a moment to the *Joides Resolution* drilling vessel legislation. Does the fact that we have not ratified the Law of the Sea have an adverse effect on this program—in other words, there is no law now applying to who owns the material from the deep seabed.

Mr. **Bloch**. I do not think it has any bearing on it, because we are using this particular ship for scientific exploration, essentially. We are not exploiting minerals or anything like that. We are really only using it for scientific kinds of investigations, and we are sharing our results with the rest of the world. So I do not think we have any problems with that law at all.

Senator **Pell**. As you do that, you will find where the nodules are, and as you know, one of the great questions is, we know there are nodules in the Central Pacific, but we don't know if there are nodules in the Atlantic areas. This information would be developed, I would think, by your vessel.

Mr. **Bloch**. Well, I am sure we will gain a lot of insight into that, but as I said before, that information is publicly available, just like any research results anywhere in the universities is publicly available, and we are not in the exploitation phase of it.

Senator **Pell**. Right, unclassified and on a program basis.

Mr. **Bloch**. Completely unclassified, and so forth, yes.

Senator **Pell**. Thank you.

Now, finally, I note with pleasure—I had a chance to go through your testimony—the important and traditional areas of science that are receiving your NSF attention. But I also noticed that perhaps the nontraditional areas that you have discussed privately, such as the psychic phenomena, are not mentioned.

Will proposals from these nontraditional areas receive the same consideration in their peer review—in other words, will they be given an opportunity to compete?

Mr. **Bloch**. Any proposal that comes in will be given the same consideration as any other proposal, and they have to pass a peer review system; they have to be judged on their own merit, on their own scientific merit, and then, last but not least, they have to be judged and put in priority order, depending on the funding that we have. But the proposals that we are getting are undergoing the same review as if they come out of physics or anything else.

Senator **Pell**. Thank you very much, and thank you, Mr. Chairman.

The **Chairman**. Thank you.

Senator Kennedy?

Senator **Kennedy**. Just very briefly, to continue along about the interest of a number of us in the whole question of research in the sea, I wonder if you are familiar with the Oceanography From Space Program that is being developed up at the Woods Hole project, where they believe they can do very important work in ocean surface wind stress, intermediate and deep ocean currents, the biological productivity, chemistry, gravity and magnetic field, sea surface temperature, sea ice, a whole range of different questions that have enormous impact not only on the oceans, but on the whole area of science and science research. It is an extremely interesting program, and I think it has been well-thought-out. I just invite your attention to that program; and I would be glad to just drop you a note on it. I would be interested if you had a reaction.

Mr. Bloch. Well, let me just make one comment on it. We are coordinating our program very closely with programs of other agencies, in particular NASA, in this regard, and——

Senator Kennedy. Are you getting good cooperation from NASA?

Mr. Bloch. I think we are getting very good cooperation—cooperation is a two-way street, as you know. We have a lot to offer to NASA, NASA has a lot to offer to us, and it is very important that we keep our programs in tune and also that we are aware of what each other's program is, and in this particular area, we are doing quite a bit of this comparing of notes, and in addition to that, funding of programs so that they are mutually essentially supportive of each other.

Senator Kennedy. Well, if there are problems, I wish you would let us know, because we want to try and ensure that you are going to get the kind of cooperation in this area which I think is enormously important.

Just briefly, two other areas. One is the vacancies in the assistant directors. You are familiar with the fact that for over 2 years, the assistant directors of the math and physical science, and the director of astronomical and atmospheric Earth and ocean sciences have been vacant. The assistant director for biological, behavioral and social sciences was vacant for almost a year until the confirmation of Dr. Kingsbury in June 1984. I think you will find that this committee has responded very effectively and expeditiously in terms of the NSF appointees that have been made by the President, and we want to continue that process.

Do you find that having these vacancies is a hindrance to your own effectiveness, functioning as the Director of the Agency?

Mr. Bloch. Oh, absolutely, it is a hindrance. Over the last 10 years, some of these assistant director positions have been open on the average of about 12 months. The two positions that you are mentioning today—namely, the AAO position and the MPS position, have been open for about a couple of years, and I think these are very important executive positions in the National Science Foundation. And if a position like that, which is equivalent to that of a vice president of development or research in an industrial company, if that company had a position like that open for that length of time, I think it would have some very dire financial consequences, and it would have some very dire consequences on us. So, we are supporting the House bill that would eliminate the Presidential appointment of assistant directors, and essentially make these appointments by the Director himself, so that we can essentially shortcut this particular process which takes a long time.

I realize this committee has been very good in responding to the submissions, but until a submission arrives here, a lot of time passes.

Dr. Schmitt. I think, Senator Kennedy, if I could, I would like to endorse that. I would point out that the National Science Foundation has 24 members of the Board that are Presidentially appointed; in addition, if this were passed, the Director and Deputy Director, which would appear to satisfy the requirements of governance and the like.

Senator **Kennedy**. Well, it certainly would seem so to me. It seems that it ought to hold you accountable and give you the tools so that you can effectively carry on the functions and purposes of the Agency. That seems to me to make a good deal of sense.

One other concern—or the Values and Ethics Program—and I do not want to beat this too hard—this program has an advisory panel with some distinguished individuals on it. In the mainstreaming of that function, I am concerned that advising are set up to review those particular functions and that they will have a similar emphasis and importance.

Having mentioned that, I hope that you will follow that issue closely.

The final point, on another question that I had regarding the failure to resolve the jurisdictional dispute between the various committees and whether that has any impact in the functioning of the Agency. Obviously, the authorization will have the additional funding, which I think you have commented on and very persuasively, I might add.

What does the failure to get an authorization over a period of time do in terms of administration?

Mr. **Bloch**. Well, I am new in town, as you know, Senator, so I do not know what kind of effect it has had in the past, so let me just reflect on this year if an authorization bill does not pass. There are a number of amendments which the chairman mentioned before, and we talked about one, namely; the assistant directorship, that are in the authorization bill that are very important to the Foundation. The engineering amendments, which have now been before you twice, did not pass the last time because it was attached to a non-NSF bill; that is certainly one. And the amendment of delegation of authority to the Director is a second one, and the assistant directorships is the third one.

These are very important issues to the functioning of the Foundation, and for that reason alone, I think we would like to see an authorization bill this year.

Senator **Kennedy**. Thank you very much. It was a pleasure to have you appear before the committee, and I will say that all of us are impressed by the job that is being done. I have enormous respect for the importance of this Agency and what it means in terms of our own country and also for people around the world. We look forward to continuing to work with you.

Mr. **Bloch**. Thank you.

Senator **Pell**. Mr. Chairman, I would add that I concur completely with Senator Kennedy's statement.

The **Chairman**. Thank you.

Senator Nickles.

Senator **Nickles**. Thank you, Mr. Chairman.

Just a brief comment. You are looking at what—$1.6 billion, is that right?

Mr. **Bloch**. Yes; this is what we are requesting.

Senator **Nickles**. And that is an increase of how much?

Mr. **Bloch**. Well, that is an increase of about $70 million over last year, and also a deferral of about $30 million. So if you compare the bottom line number, you see an increase of about $100 million.

Senator NICKLES. Where is the bulk of that $100 million going?

Mr. BLOCH. Well, the $30 million, as I said before, is a deferral from 1985 into 1986, which goes to science and engineering education. The other $70 million is spread throughout the research directorates of the Foundation. A large number of it goes to the engineering directorate, in terms of increases in engineering research centers. Another big increase is in social and behavioral sciences, about $5 million. Another increase is distributed in the various mathematics, physical, and chemistry area, but mathematics alone is getting a significant kind of an increase, about 13 percent over last year. This has been a very neglected discipline, I must say, over the last few years, and we just had a big report on it from the National Research Council that puts the focus on this particular area very well, and rightly so, and we put a big increase into that one.

So, all of the directorates have seen increases, but in particular, the new initiatives—engineering research centers, biotechnology—supercomputers is another one that I did not mention—behavioral and social sciences, and mathematics.

Senator NICKLES. Are those primarily grants to institutions or individuals for studies?

Mr. BLOCH. These are all grants to individuals and/or essentially to universities in terms of funding of institutes and new organizational activities like the engineering research centers and the supercomputers. We are building up supercomputer centers, though that does not go directly to individuals, but individuals get the benefit of it by using these supercomputer centers.

Senator NICKLES. How do you determine which university—like for the computer enhancement, there are a lot of universities, I think, that are interested in that—which ones are selected—how are they selected?

Mr. BLOCH. Well, we had to be very specific on the supercomputer centers. We got 21 proposals from 21 universities, essentially. We reviewed all these proposals by the peer review process, which essentially judged the proposals as to their technical and scientific excellence, the capability of the university to deliver on that promise, which is very important, because you need a staff and so forth, and also the accessibility of the supercomputer center by other people than just the ones that are located geographically in that university. They were rank-ordered in that particular way, and we could only fund 4 out of the 21, so the 4 best ones were funded.

Senator KENNEDY. Which universities were selected?

Mr. BLOCH. The four universities that were selected are the University of California at San Diego; the University of Illinois in Urbana; Princeton University together with about 14 other universities in collaboration in one particular center; and the fourth one is Cornell University.

Senator NICKLES. How much money are you talking about for each one of those centers?

Mr. BLOCH. Well, it varies from center to center, but the total expenditure in 1985 is $40 million. So if you average it out, it is about $10 million per center—which is not quite the right number, because some of the dollars are going for overall kinds of things like networking between the centers and so forth.

So we are talking about a significant kind of expenditure in that area.

I should also stress the point that we are leveraging the dollars, essentially. If you look at the total costs of these four centers that I discussed with you, about 60 percent of the cost is being funded by the Federal Government; 40 percent is being funded by equipment manufacturers, and by the States and the universities themselves. So the Federal Government is leveraging its funds essentially in a significant kind of way. These are very expensive undertakings, as you realize very well.

Senator NICKLES. Is the $40 million complete, or would that amount of money have to be put in for another year, or——

Mr. BLOCH. No; for years.

Senator NICKLES. For how many years?

Mr. BLOCH. Well, as long as the centers are in existence. Let me describe the problem to you. We are taking on, really, a mortgage for the future. You cannot put a center like that in place and it lives forever, because this technology, supercomputers, is moving very rapidly, and it is becoming obsolete very rapidly, and therefore, we have a responsibility to upgrade these centers every once in a while, and every once in a while could be 2 or 3 years.

Second, the centers have to provide the services, the needed services. We have to network the centers so that people who are on the other side of the country can get access to it and so forth.

So we are essentially seeing for the four centers this $40 million continues for some time to come. And that is why we are essentially increasing the dollars in 1986 in our proposal for $46 million, so that we can put in place one or two other centers. We need to get to something like 10, 15 centers, in order to span the whole requirements that science and engineering will have on these centers in the future. So we are taking on a significant amount of obligation.

Senator KENNEDY. Would the Senator just yield for a question on this?

Senator NICKLES. Certainly.

Senator KENNEDY. Just to make the record complete, could you tell us what Japan is spending on a similar function?

Mr. BLOCH. Well, let me tell you, Senator, I wish I knew the answer to that question, but from my own experience, let me be very precise.

You walk into two universities, the University of Tokyo and Kyoto University, which are two of the Imperial Universities, and you see a magnificent center for computing in both of these universities, which gets upgraded every year—that might be an exaggeration, but it gets upgraded very frequently, as new machines are being produced and designed by Japanese companies.

The one at the University of Tokyo is being essentially primarily populated by Hitachi machines; the one in Kyoto is primarily populated by Fujitsu machines. And the latest machines are installed in these centers and are available to the students, No. 1, and the faculty, No. 2, and also to industry to use, No. 3. So they have taken a very aggressive kind of a line, essentially, in those areas, and these centers are centers that we do not have in this country in the same way that they have. And the supercomputer centers I talked about are essentially trying to remedy this situation.

Let me make one other point. Europe is probably ahead of us in this regard by having established a number of university centers for supercomputing. So we are essentially trying to fill a gap which we have had for sometime and which is becoming very urgent now.

Senator NICKLES. And is this a program that you are just now letting the acquisitions go forward, or they are in the process the first year, I guess?

Mr. BLOCH. No; we just made these four awards about 3 months ago, and the plans are all in place to make that happen, so you will see some of the installations occurring toward the end of this year and the beginning of next year, so these centers are coming into being right now.

Senator NICKLES. Will they individually be making contracts with the major computer suppliers in the United States, primarily?

Mr. BLOCH. Yes. Not only primarily—only.

Senator NICKLES. I was going to say, is it exclusively U.S manufacturers?

Mr. BLOCH. Pardon?

Senator NICKLES. Are their acquisitions directed toward U.S. manufacturers, or will they also be bringing in foreign computers as well, or——

Mr. BLOCH. Well, the four centers that we just gave these awards to all have machines identified that are of U.S. manufacture and U.S. design. Two centers have an XMP Cray machine from the Cray Corp.; one has a machine which is a CDC machine, which will be updated by an ETA machine, which is an offspring of CDC, and the fourth one is an IBM machine, together with attachments, from a small company called Floating Point Corp., which has a Floating Point array process as a specialty. So they all essentially pertain to U.S. machines and U.S. manufacturers.

Senator NICKLES. Then, you mentioned the four centers—will other universities, business, individuals, be able to have access to the equipment?

Mr. BLOCH. Well, other universities and researchers have access to these, and we are monitoring that very closely, and we are making sure that that access is on an equal kind of a basis.

Business access, no, we do not have any provisions for that at all, except from one viewpoint. As a manufacturer installs equipment, he can provide some support for that, and he also can test some of his ideas there and get some feedback from it, but not to operate it, essentially.

Senator NICKLES. I did not mean so much for operations, but——

Mr. BLOCH. The benefits of it and the results will flow back to the manfacturers, yes

Senator NICKLES. One slightly different subject. You were involved—and I guess you still are, to some extent—with the ocean drilling program, and we were in the process, if I remember, of doing a joint venture with some private industry. Can you bring me up to date on that?

Mr. BLOCH. Yes. I mentioned a minute ago that we are just putting in operation a new drilling vessel, the *Joides Resolution*, which essentially has been outfitted by a private contractor under Texas A&M control, and it is being operated by a private operator, a division of Schlomberger or a wholly owned subsidiary. We also, by the way, on that particular ship, have some scientists that are under contract from private industry, in order to provide some of the important services that that ship needs in terms of essential measurements and techniques, analysis techniques and so forth. So in that sense, yes, there is some cooperation with industry. I do not know what you have in mind.

The CHAIRMAN. Senator Nickles, would you yield for just one second?

Senator NICKLES. I would be happy to.

The CHAIRMAN. I have to leave, so I would like you to finish up the hearing, if you could. You are the last to question here.

Senator NICKLES. Oh, is this our last panel?

The CHAIRMAN. Yes; this is the last panel.

Let me just say before I leave that we will place the statements of Senators Grassley, Quayle, and Thurmond into the record at the appropriate place and also the statements which have been submitted for the record by various organizations and individuals.

I have a conflict, so I must leave, so we will have Senator Nickles finish the hearing. I want to personally thank you both for being here. We appreciate the great work you are doing, and I just want you to know that we are going to make every effort to get a reauthorization bill through this year and to end this controversy between the two committees. Senator Kennedy and I are both dedicated to doing that. So we will do everything we can.

We intend to mark this bill up at the next markup, and, hopefully, that will resolve this problem once and for all. But we want to thank you both and all who work with you for the great work you do on behalf of our country. We appreciate it.

Senator Nickles, if you will finish up.

[Whereupon, Senator Nickles assumed the chair.]

Senator NICKLES. Is that ship actively drilling today?

Mr. BLOCH. Right this minute, I do not know, but it is actively out on a trip, yes, very definitely.

Senator NICKLES. I was going to ask you where.

Mr. BLOCH. It is right off the Atlantic seaboard. I think it is moving from here toward Canada, and it is doing some drilling on the way. I am not absolutely sure, but we can provide you with a schedule and everything else.

Senator NICKLES. Is the purpose for it—what—to learn more about the Earth's crust, or——

Mr. BLOCH. Yes; all of that. This is not a ship that is being designed or was designed to exploit the ocean drilling for oil or minerals and so forth. It is really to find out scientific information that furthers our understanding of the ocean and of the Earth and the relationship of the two.

Senator NICKLES. Also in the past, I think you had a program that called for some deep-sea drilling. Is that no longer active?

Mr. BLOCH. Well, this one is capable of deep-sea drilling. I do not know what you mean by deep-sea, but this one can go, to a large extent, into very deep kinds of holes. I do not know which program you are referring to.

Senator NICKLES. Is this the only ship that you have, or at one time, did you have another one?

Mr. BLOCH. Let me turn to staff.

STAFF. I think you are referring to the Challenger Deep-sea Drilling Program; the Challenger has been phased out.

Senator NICKLES. That is what I was referring to. Was that a joint venture——

STAFF. No; there is no joint venture on the Challenger.

Senator NICKLES. Thank you.

Senator Pell, do you have any additional questions?

Senator PELL. No questions.

Senator NICKLES. Well, to our panelists, we appreciate your appearance before this committee, and I will echo the chairman, that we do hope we can get an authorization bill and eliminate the hassles that we have had between the two authorizing committees.

Thank you very much.

[Additional statements, submitted for the record follow:]

ADDITIONAL STATEMENTS

Dr. David A. Hamburg, President, American Association for the Advancement of Science

Dr. Michael S. Pallak, Executive Officer, American Psychological Association

Dr. Ellis K. Fields, President, American Chemical Society

Mr. Donald G. Weinert, P.E., Executive Director, National Society of Professional Engineers

Dr. Lynn Arthur Steen, President, Mathematical Association of America

Dr. Robert F. Acker, Chairman, Public Responsibilities Committee, American Institute of Biological Sciences

Drs. Harlyn O. Halvorson and Monica Riley, Public and Scientific Affairs Board, American Society for Microbiology

Dr. John C. Crowley, Director of Federal Relations for Scientific Research, Association of American Universities, on behalf of the Association of American Universities, National Association of State Universities and Land-Grant Colleges, American Council on Education, Association of Graduate Schools, and Council of Graduate Schools

American Society for Engineering Education

Consortium of Social Science Associations

Mr. Robert W. Krauss, Executive Director, Federation of American Societies for Experimental Biology

Statement by

Dr. David A. Hamburg

President

American Association for the Advancement of Science

on

The Fiscal Year 1986 National Science Foundation

Budget Authorization

Submitted to

Committee on Labor and Human Resources

United States Senate

April 29, 1985

Mr. Chairman and Members of the Subcommittee:

INTRODUCTION

Thank you for the opportunity of submitting this statement as part of your hearings on the National Science Foundation budget request for Fiscal Year 1986. This subcommittee has a distinguished record as a strong supporter of scientific and engineering research and education and it is a personal privilege for me to present my views to you.

In beginning my statement, first let me say just a few words about the American Association for the Advancement of Science — or the AAAS as it is commonly known — of which I am the currently-elected President. Our members are about 136,000 scientists and engineers; as affiliates we have 285 other scientific, engineering and technical societies and organizations — with a total membership of around five million.

AAAS publishes the journals Science and Science 85, the latter being a high-quality general science magazine written for the interested layperson. Finally, the Association also is active in a broad variety of activities in public policy and public understanding of science and technology.

STATEMENT OUTLINE

Today I shall comment on a number of topics which provide a general setting for considering the NSF's budget request. Here is my roadmap.

- Overview of research and development — nationally and in the Federal Government
- Key international comparisons in science and technology
- Science, technology and the economy
- International science and technology
- NSF commentary
- Summary

OVERVIEW OF RESEARCH AND DEVELOPMENT

By any measure the United States invests large sums of money in research and development; the national total for 1984 — public and private — is estimated to be about $98 billion. For the past several years this total has been increasing at a rate of about 11 percent per year so it is probably not a bad guess that the 1985 total will be something around $109 billion. Yet, as I will show later, numbers alone do not tell a complete story.

For the past four decades, the United States has supported substantial investments in research and development. These investments have been made for much the same reasons that President Truman stated before a Joint Session of the Congress on September 6, 1945, only three weeks after war's end, when he said:

> Progress in scientific research and development is an indispensable condition to the future welfare and security of the Nation. No nation can maintain a position of leadership in the world of today unless it develops to the full its scientific and technological resources. No government adequately meets its responsibilities unless it generously and intelligently supports the work of science in universities, industry and in its own laboratories.

Presidents who followed Truman — Democrat and Republican alike up to and including President Reagan -- have worked with the Congress during their Administrations in building strong Federal backing for research and development. This backing has taken the form of establishing science-and-technology-based organizations, providing budget growth and taking a wide range of actions in science and engineering education, patent, tax and anti-trust areas.

The private sector -- including industry, the universities and non-profit organizations -- has likewise responded to the challenges identified by President Truman. Appendix 1 shows how the relative shares of Federal and non-Federal support of national R&D have varied over past decades and how the total in current and constant dollars has changed during the same period. After declining as a proportion of the national total in the 1950s, the non-Federal share has risen steadily since 1960. Beginning in 1977, the non-Federal and Federal shares became equal at fifty percent each. By 1979 the non-Federal share had inched ahead and gradually increased to a 54-46 percent margin which has held for the past four years.

Why Should the Public Support Research and Development?

This is a policy question more frequently discussed in terms of a specific R&D program or area; however, since there are several new Members on the Subcommittee I hope you will not mind if I briefly re-state the general case for public support of research and development. First, and quite obviously there is the R&D which must be done to support the special needs of the public and distinctive responsibilities of government -- e.g., defense, public health, environment, etc.

Less obviously, the overall benefits to the nation of much -- but not all -- long-range R&D often exceed the benefits to the organization that pays for it. Thus, competitors can benefit from corporate R&D investments by using the new knowledge generated to their own benefit. And since consumers may also benefit from lower prices and improved quality, the benefits of successful R&D may not necessarily lead just to increased corporate profits.

Further, corporations must properly consider profitability strategies and avoid what might be considered excessive R&D expenditures or R&D work that is not obviously connected to principal business interests. All in all, this has led many to conclude over time that investment by the private sector ir R&D cannot meet our national needs -- and particularly in basic research. This line of thinking leads to the argument for public sector support of Federal R&D as a major component of a total national efford in R&D -- particularly in basic research.

A second, and related, major reason for the special role of the Federal Government in R&D arises from the highly risky nature of R&D investments. One cannot be sure that any one research effort, or any small group of such efforts, will pay off. For example, in the new product development area the private sector faces odds in which only two or three of every one hundred innovative ideas becomes successful in the market place.

Comparable problems of riskiness exist in the governmental arena. However, probabilities of success are greatly enhanced when the aggregate of R&D projects and alternative paths is enlarged. In one of the critical technical and political decisions of this century, Nazi Germany chose one path -- a blind alley -- in its search for a nuclear weapon while the U.S. achieved success by following several parallel paths as insurance.

The upshot is that private investment in R&D -- particularly of a long-term, uncertain payoff nature — are frequently discouraged by high risk considerations. Communications satellites and computers are but two examples of the Federal Government taking the lead where initial risks were high, technologies were uncertain, and markets were in uncharted waters. However, both sets of industries also clearly demonstrate that Federal leadership does not imply long-term Federal domination.

All of this leads to a clear conclusion that Federal support of R&D has been and will continue to be an important investment in the future. The overall benefits appear to be large — and as will be discussed in later sections, the economic and technological benefits have worldwide significance. Generally, we believe that research and development should be supported strictly on the merits as a long-term investment.

A Look at Total Federal R&D for Fiscal Year 1986 Compared to 1985 Shows Big Increases in Defense R&D, Decreases in Non-Defense R&D, and Virtually Flat Basic Research

First, to clarify nomenclature, all of my references to FY 1986 budget numbers and comparisons are in terms of budget authority. Among the key observations are these:

- o Conduct of R&D is up from $50.4 billion in FY 1985 to $58.2 billion in FY 1986. This is an overall increase of 15.5 percent.

- The big increase, of course, is in defense. Department of Defense military R&D is up from $32.1 to $40.1 billion, an increase of $8 billion or 24.8 percent.

- On the non-defense side, the story is much different. Total non-defense R&D slips slightly in FY 1986, from $18.2 billion to $18.1 billion, a decline of about 1 percent.

NOTE: These figures have not been adjusted for anticipated inflation. If one assumes a 4 percent rate of inflation (about what the Administration seems to be forecasting), the decline in non-defense R&D becomes more significant.

- Much of the decline in non-defense R&D results from these cutbacks:
    - (-5.7 percent) Department of Health and Human Services
    - (-2.6 percent) Department of Energy
    - (-6.1 percent) Department of Agriculture
    - (-18.6 percent) Department of Transportation
    - (-26.0 percent) Department of Commerce -- especially the National Oceanic and Atmospheric Administration
    - Various Other smaller agencies

NOTE: Funds were appropriated by the Congress for FY 1985 which would have permitted NIH to make 6500 grant awards. However, the Administration proposes to hold the number of awards to about 5,000 in both years and to carry over FY 1985 funds to reduce the amount requested for FY 1986. Hence, the decline results in HHS R&D as shown above.

- Set in the context of these kinds of declines in the non-defense area, NSF's 6.9 percent increase looks rather good.

- However, on the negative side, total basic research is virtually flat -- up 1.1 percent from $7.8 billion in FY 1985 to $7.9 billion in FY 1986. This is a significant decline in constant dollars, assuming a 4 percent inflation rate. One of the major factors in this trend is the HHS/NIH story, as noted above. This is a serious problem. HHS supports about 39 percent of total Federal basic research, while the NSF supports about 17 percent and the Defense Department, about 12 percent.

Summary Point: The Amount of U.S. Investment in R&D Has Been and Remains Large — Although There Are Problems as Suggested by Certain Key Comparisons, Domestic and International

Defense/Non-Defense Comparisons: FY 1981-1986

To obtain a somewhat longer perspective than is given by a comparison of FY 1986 and 1985, I will briefly show several key comparisons for FY 1986 and FY 1981, the beginning of the Reagan Administration.

- From FY 1981 to FY 1986, total non-defense R&D is down 8 percent in current dollars and is down 21 percent in constant 1972 dollars — a substantial real decline.

- For the same period, total defense R&D is up 129 percent in current dollars and is up 67 percent in constant dollars — showing strong real growth.

- Total basic research is up 47 percent in current dollars and is up 23 percent in constant dollars, with defense accounting for about one-fourth of the increases.

- Except for the NSF and NIH, all non-defense agencies of government have experienced real reductions in their R&D budgets during the FY 1981-1986 period, some of them quite serious, e.g., the Alcohol, Drug Abuse and Mental Health Administration (ADAMHA).

These trends reflect clearly stated Administration policies and priorities during the past few years. While R&D in the aggregate — including basic research -- has been treated very well indeed, it is necessary to raise several cautionary points.

First, if defense and space R&D continue to increase their shares of the total Federal R&D budget, it will be very difficult to support other non-defense R&D even at current levels.

Next, as one looks ahead to the growing family of very large-scale technological commitments, such as the space station and space-based anti-satellite defense systems, the squeeze on available R&D resources could become severe. The combined costs of even a few of these very large projects could add up to many tens of billions of dollars.

Finally, it is surely not unreasonable to be apprehensive about substantial displacement impacts upon resources for general science.

Further, there could be severe displacement effects on the supply of scientists and engineers, on university-based research, and upon the applied research that leads to innovation and economic competitive strength.

KEY INTERNATIONAL COMPARISONS

It is clear that very large numbers are seen when we examine total R&D spending in the United States. Further, as close study of the most recent (1982) issue of the National Science Board's Science Indicators shows, the United States still maintains overall scientific and technological leadership in its absolute investments in R&D, contributions to scientific and technical literature, positive balance in R&D-intensive trade, and the sale of technical knowledge.

However, we cannot examine the large U.S. numbers in isolation. As was noted in the Science and Technology report of the Commission on an Agenda for the Eighties, "the sheer size of the U.S. economy results in larger R&D expenditures than those of other countries," but "taking these data in comparative perspective raises serious concerns about international economic competition."

Let me cite several of these comparative perspectives.

- The data in Appendix 1 of my statement shows that from the mid-1960s until about the mid-1970s U.S. R&D was on a plateau; only in 1976 did a distinct growth period begin. And while the U.S. was on this plateau, other nations were experiencing substantial real growth. One indicator of the strong, relative growth of others is this fact: In the 1970-period, total U.S. R&D was twice that of France, West Germany, the United Kingdom and Japan combined; by the 1980-period, the combined R&D totals of the same countries equalled that of the U.S.

- This observation relates directly to the data in Appendix 2 which shows that, as a percentage of GNP, total R&D spending in the U.S. declined steadily from 1964 until a modest turnaround began in 1979. The comparable numbers from Japan, West Germany and the U.S.S.R. increased steadily and substantially during the no-growth/relative decline of the U.S.

- Perhaps of more direct relevance to the competitive international economic scene is the information in Appendix 3 which shows the ratios of civilian R&D expenditures to GNP for selected countries. The substantially larger ratios for Japan and West Germany are significant and substantial in terms of their international economic performance.

- Closely related, and worth noting in terms of international business and economic competition, are the following data: In recent years, Japan has allocated only about 2.4 percent of government R&D to defense, West Germany about 9.4 percent and France about 33 percent

— compared to about 65 percent for the U.S.

- Another facet of the FY 1985-1986 no growth in Federal basic research (shown in the previous section) is demonstrated on page 199 of Science Indicators: 1982. There is a distinct and substantial underinvestment by the U.S. in the advancement of knowledge (basic research) compared to some of our international economic competitors — our major European allies and Japan. Further, as shown on pages 47-48 of Science Indicators and pages 12-14 of National Patterns of Science and Technology Resources: 1984, there were real declines in the amount of U.S. basic research from the late 1960s until the mid-1970s. At that time both the Federal Government and industry began to make constant dollar increases. While the industry component has continued to experience sustained real growth in the range of 7 percent per year, the Federal Government's support has been much less steady — ranging from a decline of 1 percent in 1982 to a 7 percent increase in 1984.

Clearly we are a nation which still maintains a scientific and technical leadership role in the world, although just as clearly others are catching up. As a cautionary note to this leadership appraisal, I would summarize several Science Indicators observations. U.S. inventive activity appears to have decreased relative to some foreign competitors. More directly troubling is that the U.S. share of world exports in R&D-intensive products continue to decline. And, as previously noted, other nations continue to increase their R&D investments and activities relative to the U.S. — particularly in civilian R&D. This is not a set of circumstances and trends which warrants complacency.

SCIENCE, TECHNOLOGY AND THE ECONOMY

Maintaining Our Scientific and Engineering Strength with Appropriate Balances Between Defense and Non-Defense R&D is Central to Powering Our Economy and Providing for Our National Security.

Economists and other scholars have given much attention to understanding the factors that contribute to economic growth — although the number of such researchers focusing specifically on scientific and technological considerations is not large. Even so, such individuals as Edward Denison, Edwin Mansfield, Theodore Schultz and William Nordhaus have reported results which suggest that scientific and technological advances, or the growth of knowledge, have been a major source of economic growth over both short and long periods since 1929.

These findings have powerful implications for policy — both in the public and private sectors. In going to the heart of the matter, investment in building the stock of knowledge -- in science, technology and education — appears to be at least as effective as investment in capital stock (production equipment, tooling and physical plant) in powering economic growth. Such ideas have important implications for the entire range of budget and tax issues now before the Congress, some of which appear as part of the on-going industrial policy debate.

As I have already noted, the significant R&D budget increases in the Federal sector of the past few years have been primarily in military R&D. And these very large increases are for the most part being allocated to weapons development. This is an important point because it is very much an open question as to how much "transfer" to the private sector and long-term economic growth results from military R&D, especially weapons development.

This defense/non-defense division inevitably becomes part of the policy debate on the respective roles of the Federal Government and the private sector as the international competitiveness topic has assumed greater and greater importance in recent years. And taken together with the earlier cited international comparisons -- particularly the greater focus on civilian R&D by our strongest economic competitors — we must be quite careful about assuming that "all is well" because aggregate Federal R&D amounts are increasing at impressive rates.

An essential aspect of "appropriate balance" must deal with the possible long-term implications of real no-growth or declines in civilian Federal R&D. Moreover, the possible reallocation of large numbers of scientists and engineers to military purposes could have serious negative consequences for the private non-defense sector.

Another central feature of "appropriate balance" deals with time horizons. There are enormous pressures at work in this country — in both the public and private sectors — for short-term payoff. Often such pressures are antithetical to the time requirements of an effective research and development program. Indeed, I would go as far as to say that a worrisome flaw in our basic thinking, our reward systems, our policy making structures, and in the ways we work and live are bound up with "the short-term syndrome."

It has been widely argued in the general media as well as in academic settings that differences in perspective on "the short-term syndrome" divide much of Japanese industrial thinking from that of U.S. counterparts. For example, it has been reported that U.S. corporate research in some industries has lagged behind that of Japan mainly because of U.S. preoccupation with short-term payoffs. It was argued that financial pressures worked against the long-term orientation needed for successful scientific work.

Pressing this point, Leighton Smith, an Arthur Anderson & Co. partner with long experience in Japan, has argued that labor relations are important but that the key to Japanese success is their orientation to a long-term point of view. Smith asserts that until U.S. boards of directors decrease their emphasis on the current quarter's results and free up management from "fire-fighting" to concentrate on markets down the road, American industry's markets will continue to be eroded by the Japanese.

The same concerns can be expressed about Federal research and development. For example, within the recent past there has been heavy pressure placed upon the Environmental Protection Agency to focus much of its R&D upon short-term problems. This is understandable in a mission-oriented agency, but it can be overdone. Such trends demand careful scrutiny by senior officials in government and in the private sector; unchecked, they would sow the seeds of future failure on a broad scale.

Industrial Innovation

In recent years, concern about the trends described above -- domestically and internationally — has taken the form of "the industrial policy debate." A specific focus of this debate has been non the rate of U.S. industrial innovation, which is seen by some as declining. Further, some have seen negative consequences of the perceived innovation decline in terms of U.S. economic growth, productivity improvement and international trade competitiveness.

This debate is very complex and is often polemical rather than analytical. We need a lot of objective inquiry from different perspectives to sort out these deeply interrelated questions and provide a stronger basis for wise policy. It may well be that we need additional ways to increase and encourage R&D investment; hence, the direct connection to today's hearing. But Federal budget increases are only one part of a much larger set of possible actions. Still, there is strong Federal interest in these issues.

In fairly rapid order, the following areas have been addressed in legislation by the President and the Congress:

- o A major R&D-related initiative of the 97th Congress was the Economic Recovery Tax Act of 1981 (P.L. 97-34). Provisions of this law are intended to stimulate private R&D investment and charitable donations of equipment to universities.

- o In the 98th Congress, P.L. 98-462, the National Cooperative Research

Act of 1984, called for the rule of reason to be applied in anti-trust law with respect to joint R&D ventures.

- In a landmark effort, P.L. 98-620 provided amendments to Patent and Trademark Laws which give exclusive licenses to private contractors for patents arising from R&D work they do for the Federal Government.

- In the area of university-industry-Government cooperation, Congress has done two things of note: (1) enacted the Stevenson-Wydler Technology Innovation Act which authorized the establishment of generic technology centers to encourage universities and industry to work together and, (2) The NSF has been encouraged to support on a modest scale university-industry cooperation.

Taken together, this is an impressive set of actions on a broad front. And while I am familiar with the jurisdiction problem in Congress, I hope your subcommittee will continue in the future to follow this area closely, providing whatever coordination and overview it deems appropriate. Much is at stake and the effort to understand these problems more deeply is certainly in the national interest.

INTERNATIONAL SCIENCE AND TECHNOLOGY

One of the main features of the domain of science and technology in the decades following World War II has been the major presence of the United States on the international scene in a variety of ways — in international governmental bodies, in international scientific groups, and as individuals. A principal tenet of our foreign policy has been the encouragement of full U.S. participation in the international scientific and engineering communities — communities which transcend political boundaries and social and cultural traditions. Sharing the results of scientific research and engaging in a wide assortment of international exchanges between and among developed and less developed nations alike have become central characteristics of these communities.

The growing interrelatedness of the world, a rising consciousness of the imperative to view many problems globally, and plain self-interest in keeping open our windows on science in the rest of the world — all these factors point toward higher priority on activities and programs in support of international science and technology. However, I regret to say that there has been some slippage in recent years. Those who care about American leadership in world science, as well as American contributions to the general well-being, should take an interest in this problem.

In the largest of our international scientific and technical programs — that of the Agency for International Development — there seems to be ambivalence: on the positive side, considerable interest in the scientific quality of specific projects; but apparently little interest in a broad, coordinated approach to scientific cooperation that would involve working closely with other government agencies and the scientific community. In 1978 Congress made a valiant effort to bring about a more effective coordination process for Federal international scientific and technical activities -- the so-called Title V role of the State Department which included an annual report. However, the annual reports have been a very low priority effort at State -- under Democratic and Republican Administrations alike — and few independent observers would declare the process or the reports effective.

I find the lack of strong focus and the paring down of our international participation especially regrettable as I look at the very special opportunities and problems emerging in the developing world. These nations are increasingly coming to recognize that science and technology offer great hope in meeting their developmental aspirations for economic and social progress. And they have great respect for American strength in science and technology. It would be an immensely grave mistake to forego these opportunities for American leadership and contributions to the general well-being. U.S. participation in selected bilateral arrangements with countries meeting a set of prescribed political criteria is a necessary but far from sufficient response to this great challenge.

Aside from humanitarian desires for generally making this world a better place for all, there are additional reasons for arguing that it is in the best interest of the United States that we help in the application of science and technology for Third World development. Trade data shows that we export more goods and services to Third World countries than to Western Europe and Japan combined. We have trade surpluses with these countries -- a rarity elsewhere in the world.

For the long-term, and in addition to the more traditional aid programs, we should be placing strong emphasis on assisting Third World countries with science-transfer and the development of effective educational structures and systems. We should be establishing a wide variety of cooperative research efforts and exchanges focused on Third World interests and problems. And where Third World countries and their scientists and engineers have the interest and capabilities we should encourage their active participation in the larger global issues that transcend national boundaries. The famine in Africa provides a powerful stimulus for change in economic development strategy with a large role for U.S.-African scientific cooperation.

UNESCO

I would like to make a few remarks on UNESCO. Let me begin by observing that the National Academy of Sciences concluded that among all UNESCO programs ($[illegible]7 million), the science programs ($14 million) rank high in terms of effectiveness and usefulness to the United States. It is my understanding that the Department of State has identified $2.7 million of its own funds to be used to cover significant U.S. international scientific activities that would go unfunded due to the U.S. withdrawal from UNESCO. Otherwise, we have been unable to discern what, if any, coverage there will be for the programs formerly carried out by UNESCO.

There is definitely nothing in the NSF budget request for this purpose. It would appear that, previous assurances notwithstanding, the UNESCO withdrawal will lead to valuable work not being done. If the

Congress is so inclined, the NSF could be given responsibility for managing the funds for the selected activities. It has a distinguished track record in managing and supporting international scientific activities.

East-West Relations in Science and Technology

As special topics under international science and technology, I would now like to address two subjects: (1) Support for the International Institute for Applied Systems Analysis (IIASA) and (2) U.S.-U.S.S.R. bilateral relationships in science and technology.

IIASA

We at the AAAS believe that IIASA effectively promotes cooperative research among established scientists -- and young scientists as well -- from East and West and some Third World countries on a number of global problems. We further believe that this is done in a context that advances overall U.S. national interests. For such reasons, AAAS has recently joined in a consortium of U.S. non-governmental scientific associations to support the work of IIASA.

The current Administration's position on IIASA is that core or institutional support not be provided from the U.S. Government, but that IIASA is free to solicit and compete for grants and contracts from U.S. science agencies, subject to State Department approval. This is a step in the right direction from an earlier and more restrictive position but it does not go far enough; a small nucleus of assured funding is highly important to provide a basis for an effective long-term program.

Therefore, I would place a recommendation before the subcommittee: that you consider recognizing the importance of IIASA both to the advancement of international science and to U.S. national interests and that you authorize institutional support at a level of approximately $1 million per year, about one-third of the former level. We judge this would be enough to assure a viable program when supplemented with project support by governments and support from the private sector.

U.S.-U.S.S.R. Relations

Relations of all kinds between our two countries have been on the decline since the late 1970s, beginning with the invasion of Afghanistan. In 1982, three of the eleven bilateral agreements between the U.S. and the U.S.S.R. in the areas of science and technology, space, and energy were allowed to expire -- with neither party seeking renewal. Since then, relations have remained chilly and, following the KAL incident in 1983, the President also suspended the transportation agreement.

However, in June 1984 the President gave an important address in which he endorsed scientific and scholarly exchanges with the Soviet Union. He announced that he was authorizing renewed cooperation under the existing agreements, and that the agencies responsible for these programs should develop more active programs. He did not suggest the re-establishment of those agreements which had been allowed to expire. Since then, the progress has been modest but real.

Given the above cited progress, the findings of a June 1983 report from the State Department to the Congress which found positive benefits to the U.S. from the U.S.-U.S.S.R. bilateral S&T program, and the recent initiative between the National Academy of Sciences and the Soviet Academy, I would ask this subcommittee to explore with the Administration the reinstatement of the bilateral S&T agreement as part of a constructive and forward-looking move in improving U.S.-U.S.S.R. relations.

SCIENTIFIC COMMUNICATION AND NATIONAL SECURITY ISSUES

I would like to take a few moments to commend the role that the NSF has played in trying to clarify the responsibilities of U.S. scientists under the Export Administration Regulations (EAR). Ambiguous language in the EAR on the export control of technical information has caused much concern and confusion within the scientific and engineering research communities over the past several years.

This confusion centers on the extent to which traditional communication is subject to regulation. I understand that the Office of the General Counsel at NSF has been instrumental in developing a proposal to revise the EAR in such a way as to relieve researchers of the burden of determining whether dissemination of knowledge to foreign colleagues and students could result in prosecution under the Export Administration Act.

The NSF proposal was reviewed and approved by an OSTP Advisory Committee on Scientific Communication late last year. The main idea of the proposal is to establish a General License authorizing the unrestricted dissemination of scientific and technical information not otherwise subject to contractually agreed upon national security or proprietary limitations. A General License would also apply to dissemination of information that is consistent with any such contractually-imposed controls, once all restrictions have expired or have been removed.

Limiting application of export controls to cases where a researcher violates contractual obligations is consistent with the recommendations of a panel convened by NSF in January 1984 and those of the Corson Panel convened by the National Academy of Sciences in 1982. Both panels concluded that the Government should rely primarily on contractual rather than regulatory restrictions in the rare instances where some information dissemination restrictions on scientific research are appropriate.

In concluding this section, I again would like to commend the NSF for taking the lead in airing these vitally important issues and in developing a workable solution to the problems encountered by the research communities in interpreting the EAR. Achieving a proper balance between legitimate national security interests and those related to freedom of scientific communication requires a fine sense of judgment. I hope the proposal, as approved by the OSTP Advisory Committee, is adopted by the Department of Commerce quickly so that the chilling effect of current EAR language on scientific communication can be vanquished.

COMMENTARY ON THE NSF BUDGET REQUEST

I do not intend to discuss specific budget numbers or line items in any detail. However, I am prepared to make a number of comments about the budget and will also provide several recommendations for you to consider.

As I noted briefly in the overview of R&D section, it seems clear that the NSF budget — at the aggregate level — fared well in a climate of strong pressures to reduce spending and to come to terms with large deficits. The Administration is to be commended for adhering to its course in recent years of strongly supporting investment increases in the research programs of the Foundation. The budget increase this year of nearly 7 percent — primarily for research — is encouraging in an otherwise no growth picture for basic research, as was pointed out in the overview.

Those of us in the scientific community have been heartened by the vigorous way in which new Foundation Director Bloch has moved into his job and by the open way he has made himself available to advice from a wide variety of sources. He is a person of exceptional distinction. And while it may be possible to take exception to some of the organizational, program and budget decisions, it appears to be a management environment in which reasonable people may differ but still come to an understanding on reasonable terms.

Science and Engineering Education

Now I would like to state my views on science and engineering education. This is the organizational and program area where we find ourselves greatly puzzled and, as are many in the scientific and engineering communities, increasingly restive about the limited progress being made by the Foundation in "getting its act together." Again, since there are new members on the subcommittee, we would like to review a number of key points and highlights covering the past five years.

Background

Starting in 1980 with the publication of Science and Engineering Education for the 1980s and Beyond (prepared by the NSF and the Education Department), there has been a large number of studies, reports and books, all of which, in one way or another, point out the urgent need for the nation to strengthen its science and mathematics education. All of them have stressed that it is a time for action, and that this action must come from every level: local, regional, state and national. They have also stressed that there is so much to be done, that there are important roles to be played in both the public and private sectors.

While there are differences on just what the Federal role ought to be, there seems to be no disagreement that there is a substantial Federal role. Furthermore, there appears to be widespread agreement that the NSF and the Department of Education both need to provide some resources, as well as constructive leadership.

The Congress has decided, along with the Administration, that the major role of the Department of Education in relation to science and mathematics education is to take the form of block grants to the states, and the NSF is to remain as the chief Federal instrument for influencing and providing leadership nationally in science, mathematics and engineering education.

Among the national studies, one of the most important was commissioned by the National Science Board itself. Called the Commission on Precollege Education in Mathematics, Science and Technology, its findings were made available in "A Report to the American People and the National Science Board," entitled Educating America for the 21st Century: A Plan of Action for Improving Mathematics, Science, and Technology Education for all American Elementary and Secondary Students. The objective was to insure that the achievement of the American students would be the best in the world by 1995. The National Science Board endorsed the report.

Where Do Things Stand?

That clarion call for action has not, however, been followed up with any notable vigor by the NSF itself. This, despite firm notice from Congress since 1983 that, like it or not, the NSF was going to have the science education function. It seems reasonable to suppose that the NSB Commission report would be the first step in a thoughtful and energetic response to national needs as set forth in the report itself and which were strongly emphasized by Congress.

First, for the past several years NSF has not spent the money made available to it by Congress for precollege science and mathematics education.

- In FY 1983 $15 million was available but only $1.1 million was spent.

- In FY 1984 $68.6 million was available (from new appropriations and carryover) but only $37.2 million was spent.

- In FY 1985 $87.0 million is available (from new appropriations and carryover) but $31.4 will be carried over to FY 1986.

No one is suggesting that NSF spend money recklessly, but surely over such a span of years it would be possible to expend these relatively small amounts thoughtfully and usefully, when the public demand and the fundamental requirements are so great. Of course, the NSF and the nation itself suffered a serious blow when the Education Directorate was essentially destroyed in the first year of this administration. Surely the time is at hand for recovery. This is an urgent national need. No other entity, public or private, can replace the NSF in science education.

There is real urgency for NSF to set in motion the planning steps on how to organize itself and conduct effective programs according to a coherent strategy in keeping with the Board mandate. Congress itself was troubled by this state of affairs and, apparently losing patience, last year decided to require the NSF to get itself on track in education. It appropriated $2 million to enable NSF to seek outside help in setting specific goals, short- and long-term, in aligning priorities, and in budgetary and organizational planning.

As of now, no contract has been set in place and it is unknown when such a plan will finally emerge. This is a matter you may wish to inquire into. It is possible that your subcommittee may wish to place this topic on your oversight agenda. We deeply believe that continuing Congressional interest will be essential to achieve the national goal in the critical field of science education. Your efforts can only be a positive help to Mr. Bloch as he sorts out the pieces of this puzzle and provides the necessary leadership.

Other Actors in Science and Engineering Education

The wide range and depth of problems in science and engineering education identified in the previous section have drawn a great deal of attention and action on the part of many organizations -- public and private. I am heartened by the growing variety of the responses by states, by school districts all over the country, by corporations, by private foundations (such as my own), by science museums, and by professional associations such as the AAAS.

Each of these entities tends to focus on special elements of science and engineering education. For example, a number of corporations have chosen engineering schools as their focus; the states have been revising curriculum and teacher requirements and standards; and the AAAS has concentrated its energies and programs -- with substantial private foundation support -- on pre-college science and mathematics education.

Because they do not usually gain as much public attention as some of the other activities, I would like to point especially to the growing roles of science and technology museums in science education. All over the country, science museums are experimenting with new forms of reaching out to the people in their areas, and especially to the children. We at the AAAS have found the museums to be uniquely valuable partners in the realm of science education; thousands of our members are now participating in volunteer programs with science museums all over the country.

It is possible that some could conclude that because of this array of activities in science, engineering and mathematics education, there is a diminished role for the NSF. We strongly differ with such a point of view. Indeed, as I stressed earlier, the need for the intellectual leadership and coordinating role of the NSF is stronger than it ever was. No state or foundation or corporation can replicate the special kinds of talent that the NSF can marshall in order to develop the long-range strategies and programs necessary to cope with the urgent problems that face us on a national scale.

NSF International Science and and Engineering Programs

Although I have discussed general international science and technology matters at some length earlier, I would like to focus this part of my testimony directly on NSF international programs. Appendix 4 contains a summary of what NSF considers as its international activities.

A review of why NSF supports international activities in science and engineering reveals two reasons: the first relates to the enhancement of science and engineering in the United States and maintaining a position of leadership in critical areas of science and technology through close contacts with centers of excellence in other countries; the second relates to U.S. foreign policy interests and the role of science and technology in advancing those interests.

Often the nature of the research enterprise requires a strong international component for certain problems which are global in nature such as research on the weather, oceans, climate and various biological, geological and chemical cycles. In yet other cases, international collaboration is necessary to provide U.S. scientists with access to specific resources — physical, biological or geological available only in other countries. Finally, in some fields of research world leadership is found in the form of people and facilities in other countries; the ability to collaborate and communicate with these leaders is essential to the strength of U.S. science and engineering.

In support of foreign policy goals, international science and engineering activities can contribute to strengthening our national defense, to improving the economies of developing nations as earlier discussed, to reducing East-West political tensions and improving general understanding, and to strengthening ties with our allies. Increasingly the Executive Branch has used bilateral science agreements as a form of cooperation with other nations.

For all these reasons, maintaining close and varied links between science and engineering in the U.S. and other countries is vitally important to both domestic and foreign policy goals. The question, then, is how international activities fare in the proposed NSF budget.

First, as Appendix 4 shows, the total seems to be rising modestly; however, it is important to note that the small parts of the budget related to cooperative science efforts under a large number of bilateral agreements administered by NSF actually have been reduced in FY 1986. This turns out to be a few hundred thousand dollars per country for a total of about $7 million. I find this priority rather difficult to reconcile with the overall importance of these cooperative agreements. The $7 million comes from subtracting the National Academy of Sciences amount (for administering special agreements with the Peoples Republic of China, for example) of a little over $4 million form the $11.4 million estimate for FY 1986.

Today, I am not prepared to address in detail other elements of the international program — such as the composition of the disciplinary area research projects which NSF estimates at $81.5 million for FY 1986. In view of the intimate way the world is now bound together, and the growing concerns about American leadership, the subcommittee may well find it useful to inquire into this matter at a subsequent date.

In summary, I raise a cautionary word as to whether the budget reflects the kinds of priorities which should be accorded the international area — or whether we see in another way some of the "pullback" across-the-board in international science and technology I referred to earlier.

Programs for Women, Minorities and the Handicapped

First, and very important, we wish to applaud Mr. Bloch for his concerted efforts to increase the amount of data available in the NSF needed to monitor its equity efforts. In terms of specific actions, we think it very positive that the following actions have been or are being taken:

- The establishment of one new program and one new activity last year that address needed areas: (1) Research Opportunities for Women, a program for new women investigators who have not been a recipient of previous federal research support as a project director; and (2) Research Facilitation Awards, an activity that would augment grants — to provide additional support that might be required by a disabled scientist, engineer or student on a grant — to adapt scientific equipment, or obtain specific assistance to accommodate to a disability.

- The support of programs in FY 1986 that have special impact on minorities, women and handicapped.

- The continued emphasis in every directorate to address equity concerns.

NOTE: For a more complete review of the special programs in this area, please see Appendix 5.

On a less-than-positive note, however, I need to point to the absence of programs at the college level in Science and Engineering Education. This absence greatly hampers efforts for minorities, women and handicapped persons because there are retention problems at this level which cannot be addressed under the present program structure. At the same time, we need to expand the use of the option to involve undergraduate students from these groups in research funded out of the regular research grants.

Further, there is significant underfunding of the Research Opportunities for Women Program. Even a doubling would not begin to address the level of proposal pressure being experienced. Four hundred and forty applications to the program in FY 1985 will lead to the granting of seven awards.

More generally, we hope to see improvements in the Directorates in their efforts to increase participation by minorities, women and physically handicapped persons. We would like to see the efforts to bring these groups into the scientific mainstream integrated into the on-going operations of the Foundation. Until that integration takes place on an adequate scale, we need strong targeted programs that build toward enduring institutionalization.

Finally, we hope that the reorganization of the National Science Board means growing attention to equity issues within the broad context of NSF's concern for talent. The largest pool of talent available to do the work of science in the next century is the one whose potential to contribute has been ignored too long — minorities, women and handicapped persons. The nation must fully utilize this great pool of talent in the future.

Program on Ethics and Values in Science and Technology

In the course of reviewing a large, multi-million dollar budget, it is all too easy to overlook small programs which have been set aside to make way for new initiatives or for projects which have been judged to be of higher priority. One such item is the NSF Program on Ethics and Values in Science and Technology — or EVIST as it is called. I deeply regret its absence.

EVIST has provided support for research studies, workshops, conferences, symposia and publications on a variety of important topics. The goal of the program has been to provide an explicit focus on the ethics and values associated with the acquisition and use of scientific and technical knowledge. It has represented a symbolic commitment by the NSF to the principle that scholarly research has much to contribute to our understanding of contemporary controversies involving science and technology. One of the great tasks of our time is to work toward the judicious use of technology. We are entering new and difficult terrain. Ethical problems must be addressed.

EVIST is the only program in the entire Federal Government which has provided sustained support for work on ethical and value issues arising from biomedical research as well as science and technology more generally. A brief review of recent EVIST awards illustrates the importance of the research topics it has supported:

- Ethical and value conflicts in food safety decision making
- Ethical implications of trade secrecy, patents and related property controls for science and technology
- Risk-setting, risk-taking, and the introduction of new technologies
- Ethical issues in approaches to research on mental illness and women
- Ethical responsibilities and practice in the use of animals in biomedical and behavioral research
- Ethical issues in human gene therapy
- Moral decisions in discovering and controlling occupational health hazards

The AAAS and other professional groups and academic centers have set up science and ethics programs over the past decade, many of which have been stimulated by the EVIST program. For example, the AAAS has focused increasing attention on the ethics and values area through its Committee on Scientific Freedom and Responsibility; moreover, we have incorporated such ideas into the fundamental objectives of the Association. I find it rather ironic that this very success of the EVIST program is one of the major reasons being stated by NSF for its discontinuance; it is as if the undisputed success of the NSF in helping to establish scientific centers of excellence in chemistry or mathematics were used to justify withdrawal of NSF support.

In effect, the NSF position is that supporting the EVIST-type research should now be a private sector responsibility. In part they are correct; foundations, universities, corporations, and associations such as our own should be supporting work in these areas. But is not correct to conclude that these issues are totally a private sector responsibility. We believe that the NSF can and should continue to provide an intellectual leadership role and act as a catalyst for other organizations — a role it has performed well and often.

We believe that the Federal Government — and the NSF — cannot afford to look the other way when crisis and conflict arise from ethical and value issues in science and technology. In the absence of sustained and vigorous scientific inquiry, we are more likely to be left with rhetoric, polemic and anecdote as the basis for solving such problems.

I hope the subcommittee will agree. Specifically, we hope that in your review of this budget you will consider continuation of the EVIST program in its modest form.

Social, Economic and Behavioral Sciences

These program areas have been near the center of discussion of NSF budget reviews in recent years. It is encouraging that the social and economic sciences areas has received a healthy increase for FY 1986 of $5.4 million to a total of $33.9 million; this is a rather better showing than was achieved by the behavioral sciences where the increase of about three percent probably means some loss in constant dollars.

We hope the subcommittee will continue its support for these science areas; congressional actions have been vitally important in recent years in keeping research in these fields alive.

After all, what is more important in the world today than a deeper understanding of conflict resolution? Similarly, recent studies from the Institute of Medicine, National Academy of Sciences, clarify the great importance of behavior for health. Progress here requires strong research in behavioral science and collaboration with biomedical science.

SUMMARY

Mr. Chairman, again let me thank you and the other members of the Committee for this opportunity to present my views. In my appearances before congressional committees over the years I have developed a high respect for those of you in the Congress. It is reassuring to observe at first hand the deep understanding held by those in Congress on the vital set of relationships between science, technology and the well-being of our nation and the rest of the world.

Finally, I would like to make several concluding observations and recommendations in summarizing my views:

(1) In looking at the overall R&D picture, the U.S. remains strong and the general state of science and technology is reasonably healthy. My major qualifier is that we must be very careful not to tilt too far toward

military R&D in relation to non-defense R&D. Close watch on this balance and its long-term implications is warranted.

(2) Examination of key international indicators suggest that other nations are gaining rapidly on the U.S. in vital areas of science and technology — and particularly in areas related to performance on the highly competitive international economic scene. This is an important policy domain where Congress has been particularly active in recent years; your continued oversight in this area is strongly urged.

(3) Greater national focus — public and private — must be placed on longer-range perspectives vis-a-vis short-term outlooks.

(4) The importance of international science and technology calls for your close attention in the form of budget and policy reviews — particularly for cooperative scientific and engineering programs, including those between the U.S. and the U.S.S.R., and especially those involving the developing countries.

(5) Another special feature of international science and technology which we commend to your attention is the delicate and intricate balancing of interests between national security and freedom of scientific and engineering research objectives.

(6) Overall, the budget for the National Science Foundation is a good, strong product. In a time of fiscal pressures, it represents a sound investment in the nation's future. Only in science and engineering education do we seem to have views that differ sharply from those of the Foundation; in the other areas, as noted below, we suggest several modest

changes for your consideration.

- NSF does need to give science and engineering education a higher priority, get itself organized and formulate a strategic set of programs which will meet urgent national needs.
- In the context of the overall importance of international science and technology, the downward direction of cooperative science budgets at NSF is not the way to go.
- While much progress has been made, the NSF needs to maintain a strong focus on integrating the concerns of women, minority and handicapped persons into the mainstream of research directorate activities.
- The EVIST program should not be terminated; it is far too valuable in its catalytic role, especially considering the modest level of funding at about $1 million per year.

This concludes my statement. Thank you.

APPENDIX 1

Trends in Federal and non-Federal R&D outlays: 1953 and 1960-84
[Percents]

YEAR	FEDERAL				NON-FEDERAL	Total National (Constant Dollars)	Total National (Current Dollars)
	TOTAL	Defense related	Space related	Civilian related			
1953	54	48	1	5	46	$8,677	$5,124
1960	65	52	3	9	35	19,635	13,523
1961	65	50	6	9	35	20,584	14,316
1962	64	48	7	9	36	21,750	15,394
1963	66	41	14	11	34	23,733	17,059
1964	66	37	19	9	34	25,857	18,854
1965	65	33	21	11	35	26,896	20,044
1966	64	33	19	12	36	28,442	21,846
1967	62	35	14	13	38	29,241	23,146
1968	61	35	13	13	39	29,833	24,605
1969	58	34	11	13	42	29,586	25,631
1970	57	33	10	14	43	28,613	26,134
1971	56	32	9	15	44	27,814	26,676
1972	56	32	9	15	44	28,477	28,477
1973	53	30	8	15	47	29,147	30,718
1974	51	27	8	16	49	28,763	32,864
1975	51	26	8	17	49	28,153	35,213
1976	51	26	8	17	49	29,510	39,018
1977	50	25	8	17	50	30,506	42,783
1978	50	24	7	19	50	32,002	48,129
1979	49	23	7	19	51	33,612	54,933
1980	47	22	7	18	53	35,133	62,618
1981	46	23	7	16	54	36,859	71,912
1982	46	25	7	14	54	38,742	80,317
1983 (est)	46	27	6	13	54	40,784	88,153
1984 (est)	46	29	6	11	54	$43,329	$97,895

NOTE: Detail may not add to 100 percent because of rounding.
SOURCE: National Science Foundation

APPENDIX 2

National Expenditures for Performance of R&D as Percent of Gross National Product (GNP) by Country: 1961-85

YEAR	FRANCE	WEST GERMANY	JAPAN	UNITED KINGDOM	UNITED STATES	U.S.S.R.
1961	1.38	NA	1.39	2.45	2.73	NA
1962	1.46	1.25	1.47	NA	2.72	2.64
1963	1.55	1.41	1.44	NA	2.86	2.80
1964	1.81	1.57	1.48	2.29	2.96	2.87
1965	2.01	1.73	1.52	NA	2.90	2.85
1966	2.06	1.81	1.46	2.31	2.89	2.88
1967	2.13	1.97	1.52	2.29	2.89	2.91
1968	2.08	1.97	1.60	2.25	2.82	NA
1969	1.94	1.82	1.64	2.27	2.72	3.03
1970	1.91	2.06	1.85	NA	2.63	3.28
1971	1.90	2.20	1.85	NA	2.48	3.46
1972	1.86	2.21	1.86	2.11	2.40	3.71
1973	1.76	2.09	1.90	NA	2.32	3.81
1974	1.79	2.13	1.97	NA	2.29	3.74
1975	1.80	2.23	1.96	2.19	2.27	3.78
1976	1.76	2.15	1.93	NA	2.23	3.54
1977	1.76	2.15	1.93	NA	2.23	3.54
1978	1.76	2.24	2.00	2.24	2.22	3.54
1979	1.81	2.40	2.09	NA	2.27	3.59
1980	1.85	2.42	2.22	NA	2.38	3.75
1981	2.01	2.49	2.38	2.47	2.43	3.75
1982	2.11	2.58	2.47	NA	2.58	3.68
1983 (est)	2.16	2.57	2.58	NA	2.62	NA
1984 (est)	2.19	NA	NA	NA	2.63	NA
1985 (est)	NA	NA	NA	NA	2.71	NA

SOURCE: National Science Foundation, Organization for Economic Co-operation and national country sources.

APPENDIX 3

Estimated Ratio of Civilian R&D Expenditures[1] to Gross National Product (GNP) for Selected Countries: 1967-82

YEAR	FRANCE	WEST GERMANY	JAPAN	UNITED KINGDOM	UNITED STATES
1967	NA	NA	1.51	NA	1.88
1968	NA	1.80	1.59	NA	1.83
1969	NA	1.87	1.63	NA	1.79
1970	NA	2.01	1.79	NA	1.75
1971	1.46	2.25	1.84	NA	1.68
1972	1.47	2.20	1.84	1.50	1.63
1973	1.39	2.07	1.89	NA	1.62
1974	1.43	2.12	1.96	NA	1.57
1975	1.46	2.24	1.95	1.41	1.68
1976	1.44	2.15	1.94	NA	1.72
1977	1.44	2.18	1.92	NA	1.67
1978	1.41	2.18	1.94	1.52	1.69
1979	1.43	2.46	2.05	NA	1.75
1980	1.42	2.53	2.15	NA	1.86
1981	NA	2.58	2.34	NA	1.87
1982	NA	NA	NA	NA	1.96

[1] National R&D expenditures, excluding government funds for defense.

NA=Not available.

SOURCES: National Science Foundation and Organization for Economic Cooperation and Development

APPENDIX 4

NSF

	$ Millions				
	1983 Actual	1984 Actual	1985 Request	1985 Current Plan	1986 Estimate
INTERNATIONAL COOPERATIVE SCIENTIFIC ACTIVITIES					
o International Cooperative Science	—	11.8	4.4	12.5	11.4
o International Scientific Organizations and Resources	—	1.0	1.1	1.1	0.7
Sub-Total	9.9	12.8	5.5	13.6	12.1
INTERNATIONAL RELATED RESEARCH PROJECTS					
o Disciplinary Activities	—	73.5	—	76.9	81.5
SPECIAL PROJECTS					
o Antarctic Programs	—	22.5	—	24.8	26.8
o Ocean Drilling	—	26.3	—	27.6	28.9
	—	147.9	—	156.5	161.4

Source: AAAS

APPENDIX 5

Programs for minorities, women and physically handicapped persons at the National Science Foundation

BACKGROUND

The NSF prides itself on the fact that programs it has supported were always integrated. This includes teacher institutes held in the 1960s on the campuses of "white" institutions in the Southern U.S. But NSF's first attempt to proactively address the underrepresentation of minorities in science came via targeted programs established in the early 1970s.

The National Science Foundation has had various targeted efforts to address the problems of access to science and engineering careers by women, minorities and/or physically disabled persons since the 1970s. These have varied in scope depending on the interpretation of civil rights laws within the agency at the time.

COSIP-D was the first such targeted program. Established in 1972, its aim was to build institutional capability in science and engineering at historically Black colleges and universities. The program was eventually expanded to include colleges and universities whose predominant student population consisted of groups underrepresented in science and engineering (e.g., American Indians, Alaskan Natives, Blacks, Mexican Americans, Puerto Ricans). When the Department of Education (ED) was established in 1980, this program (now known as the Minority Institutions Science Improvement Program or MISIP) along with pre-college teacher training programs for grades K-5, were transferred to ED.

PRESENT STATUS

In ED, MISIP has had a rather tumultuous history with little sympathy or support from top administrators who have limited ground in running merit-based college level science education programs. There have been numerous attempts by Congresspersons to intervene on the program's behalf but with no results. The program remains "at risk" with only one full time staff person trained in science or mathematics, supporting practices and standards aimed at maintaining the integrity of the program. MISIP needs to be returned to NSF where it could provide a base around which to build other college-oriented programs.

In the mid 1970s, the NSF funded experimental projects and programs aimed at identifying and addressing the barriers to women and minorities' full participation in science and engineering. In the late 1970s, a formal Women in Science program was established which supported three types of activities: a contract to test the viability of a Visiting Women Scientists program for the high school level; Career Days for Women in Science and Engineering initially aimed at the college level; and a reentry program to help retool women who already held degrees in science but who may have been out of the workforce because of family responsibilities. All three programs demonstrated their successfulness in various ways.

One might well ask why were these particular programs supported: these were not necessarily the most important or leveraging activities that NSF might have undertaken. But out of the many program options examined by the National Science Foundation, these three were among those that, according to legal interpretations, could be done without violation of existing anti-discrimination laws. These programs were effective, but disappeared in the virtual dismantling of Science and Engineering Education (SEE) in 1981.

Programs for physically handicapped persons were given to NSF in 1977 by the Congress. This was a new special population to the Foundation even though civil rights legislation related to disability was passed earlier in the decade. The program was funded until 1981. Among the projects supported by the NSF PHIS (Physically Handicapped In Science) were curriculum and materials development projects for teaching science to sensory impaired students, summer programs for disabled youth, and workshops for teachers on how to teach science and math to students with various disabilities.

Two other targeted programs were also present in the old Directorate for Science Education: Resource Centers for Science and Engineering (RCSE) and the Minority Graduate Fellowship Program, both congressionally mandated. Minority science organizations testified for and supported the concept of Resource Centers. The program was based on the idea that the problems of minority access to science and engineering were systemic and that the solution must also be systemic. RCSE stressed the notion that all elements must come together in an overall plan to change the perception, teaching, access, place of science and technology in the school, homes, communities and higher education institutions. Each of four centers was funded at $2.8 million for four years. These centers were based at Atlanta University to serve the Southeastern U.S. (1978); University of New Mexico and New Mexico State University to serve the Southwestern U.S. (1979); University of Puerto Rico Rio Piedras and Mayaguez to serve the island (1980); and City College of the City University of New York to serve the Northeastern U.S. (1981). It was originally intended that seven centers would be established, booster grants given to help maintain existing centers, and a network of all centers developed to facilitate sharing of ideas. These plans were dropped in 1981. Two centers are still in operation (Puerto Rico and City College), but these will run out of NSF funds in 1985. The centers were very successful in developing, testing and institutionalizing effective intervention programs for minority and disadvantaged students.

The Minority Fellows program was developed because of the small number of minority students who were successful in the extremely competitive regular fellowship competition at NSF. Talented minority students found it difficult to overcome years of cumulative educational disadvantages and demonstrate their potential for success by way of high scores and grade point averages. The Minority Fellows program was part of a negotiated compromise between the House and the Senate in 1978 which disagreed over whether individual or institutional support was the better route to increasing the flow of minority talent into science and engineering careers. The fellows program persists to this day in the NSF since the problem that stimulated its formation persists -- too few minority science and engineering Ph.D's and too little success by minority applicants in the regular fellows program. The program also persists because it was yoked to the regular fellows program. The Minority Fellowship program gave NSF something else -- very clear, explicit report language that made clear legislative intent to address underrepresentation by minorities in science and engineering through programs -- institutional and individual. Such a broad mandate could not have existed in the past.

A modest program also existed in NSF in the early 1970s to support research by investigators in minority institutions and this continues as the Research Improvement in Minority Institutions Program.

In 1980, Congress passed Title II of the NSF Authorization Act of 1981 -- Equal Opportunity in Science and Technology. The law authorized support for a variety of programs, established the NSF Committee on Equal Opportunities in Science and Technology (CEOST), required biennial statistical reporting by NSF on the status of women and minorities in science and engineering, and required several reports from the White House.

The establishment of CEOST by NSF Director, John Slaughter, put into place a mechanism for ongoing monitoring and advisement on equal opportunity issues. When NSF Director, Edward Knapp, explored the place of targeted programs vs. mainstreaming equity efforts, CEOST was in place to help raise key questions about accountability, and monitoring. The decision was made to keep existing targeted programs such as Minority Research Institutions, and Visiting Professorships for Women but at the same time to require the various directorates in the Foundation to outline in detail how they would increase the participation of minorities, women and disabled persons in all their activities — as peer reviewers, on advisory committees and panels, as project directors, etc.

NSF Director Erich Bloch has worked effectively with CEOST and has moved forward aggressively to tackle such issues as: obtaining race, gender, disability information on project directors, assessing the current status of minorities, women and disabled persons on advisory committees and panels within the Foundation, developing a management information system that will allow NSF to monitor itself on a number of different equity indicators.

American
Psychological
Association

STATEMENT OF

Michael S. Pallak, Ph.D.

Executive Officer

American Psychological Association

on behalf of

THE AMERICAN PSYCHOLOGICAL ASSOCIATION

before the

UNITED STATES SENATE

Committee on Labor and Human Resources

on the subject of

NATIONAL SCIENCE FOUNDATION AUTHORIZATION

Fiscal Year 1986

April 30, 1985

The Honorable Orrin G. Hatch Chairman

1200 Seventeenth St., N.W.
Washington, D.C. 20036
(202) 955-7600

SUMMARY OF MAJOR POINTS

The American Psychological Association makes the following points concerning the National Science Foundation's Budget for Fiscal 1986:

- APA strongly supports the President's Fiscal 1986 $1.6 billion budget proposal for the National Science Foundation. We specifically commend the President for proposing to increase funding for the Biological, Behavioral and Social Sciences Directorate by 8 percent and the Behavioral and Neural Sciences Division by 6.6 percent over Fiscal 1985 levels. We believe these proposed budget increases -- advanced even in this time of fiscal austerity -- reflect the growing appreciation of the role behavioral and social sciences play in strengthening this country's scientific enterprise.
- APA urges the Committee to ensure that NSF continues to provide coordinated and integrated funding for projects investigating the ethical and moral implications of the nation's continuing scientific and technical advances. Support for these studies through the Ethics and Values in Science and Technology program at NSF totaled $1 million in Fiscal 1985. In Fiscal 1986, however, the Administration has proposed to eliminate funding for this program. We hope to see this important program continued.
- APA urges the Committee to reiterate its support for the strengthening of science education activities at NSF. APA is concerned that this is the third consecutive year in which NSF will not be spending all the funds appropriated for the Science and Engineering Education Directorate. We hope that in Fiscal 1986, NSF will choose to more fully address this area of national need rather than defer support to some future year.

Thank you for this opportunity for the American Psychological Association to submit its views on the National Science Foundation Authorization for Fiscal Year 1986. The American Psychological Association (APA) represents the concerns of over 76,000 psychologists, many of whom conduct important research that is funded by the National Science Foundation.

Before addressing the specific Fiscal Year 1986 Authorization for NSF, we would like to briefly comment on what we view as an alarming development--a movement in Congress to freeze Fiscal 1986 science budgets at Fiscal 1985 levels. We recognize the pressures that the Congress faces to restrain federal spending. That task--to ensure the support of essential Federal programs while taking meaningful action to reduce the Federal budget deficit--is critical to the continued growth of this nation. In helping to set that balance, this Committee will send out an important signal on the contribution that sciences make to strengthing our position both at home and abroad. We would hope that Congress would carefully weigh the potential long-term effects of short-term, across-the-board budget freezes.

Unfortunately, recent authorization votes in the House of Representatives for both NSF and the National Aeronautic and Space Administration, have not been encouraging. Based on this Committee's sensitivity to the sciences, we are hopeful that your deliberations will again demonstrate strong support for the NSF and the programs it funds.

PSYCHOLOGICAL RESEARCH

We feel it would be useful to briefly describe the areas research psychologists pursue in behavioral and social science projects. The breadth of their activities forms an impressive array of inquiry ranging from physiological phenomena to social phenomena. Research areas include such diverse concerns as normal and abnormal brain growth and development; educational processes such as learning and memory; the study and design of organizational structures and functions such as corporate management and personnel policies; experimental studies exploring the physiological roots of human behavior; research in perception and movement used to develop optimum designs for many processes and systems such as the cockpits of sophisticated aircraft; the study of social institutions and interactions; survey research; and the development of standardized tests for use in education and the private sector. Psychological research has implications for addressing major issues in health care, productivity, education, substance abuse, and managing human resources. In the last five years, psychological contributions in these areas have been recognized through the presentation of two Nobel prizes and many other national and international awards to distinguished psychologists.

NSF FISCAL YEAR 1986 AUTHORIZATION

The APA appreciates this opportunity to strongly endorse the Administration's Fiscal 1986 budget request for NSF. We commend the President for proposing to increase support for NSF by 4.4 percent, even in this time of fiscal austerity. More specifically we believe that the 8 percent increase for the Biological, Behavioral and Social Sciences Directorate, and within it increases for the Behavioral and Neural Sciences program would provide badly needed support. The Behavioral and Neural Sciences division, which uses approximately 40 percent of its budget to fund behavioral and social science research, is to receive a 6 percent increase over Fiscal 1985 levels. Because of the basic nature of most NSF support, behavioral scientists conducting basic research often depend on NSF as their sole source of Federal funding.

As this Committee knows, behavioral and social science programs at NSF in years past have not been treated equitably in budget proposals. Fortunately, that trend was turned around in the last two years, due in large part to Congressional support for quality research in these important areas of science. We appreciate that support.

ETHICAL RESEARCH ON SCIENCE AND TECHNOLOGY

As the pace of revolutionary scientific advances continues to quicken, it is imperative that studies of the moral and ethical questions often raised by these new technologies and processes be continued. APA urges the Committee to ensure continued NSF support for projects in this area. In the Fiscal 1985 budget, the NSF Ethics and Values In Science and Technology program, known as EVIST, is funded at $1 million to support these studies. Committees in both the Senate and House have rejected the Administration's request for the elimination of the EVIST program in Fiscal 1986. We concur with that position, and urge the Committee to support EVIST at the levels it received in

Fiscal 1985. We believe that the EVIST program, as currently constituted, is the most effective vehicle for continuing these important studies.

We would note for the record, however, that the concerns we raise over the EVIST program do not outweigh the positive regard in which we hold the Administration's Fiscal 1986 budget for NSF. We are pleased that the President recognizes the critical contribution to our nation that is made through a continuing commitment to the behavioral and social sciences. These are the sciences that study human behavior and thought, and there is hardly a single national problem the solutions to which do not demand some understanding of human nature.

SCIENCE AND ENGINEERING EDUCATION

APA has always strongly supported the science education component at NSF. It is within the Science and Engineering Education Directorate that two of the Foundation's primary functions--the support of basic research and the development of future scientists and engineers--come together in sharpest focus. We share concerns expressed by Congress and this Subcommittee many times that improvement is needed in our nation's science education activities. Psychologists and others involved in education-related research have made significant strides toward establishing a knowledge base on the processes of cognition, learning and teaching; and are applying those findings to develop methods to improve science education in the country's classrooms. Advances in science education must continue if we are to maintain this nation's technological edge in the international marketplace and develop the cadre of scientists and engineers the future demands.

It is the critical need for improvements in science and engineering education which prompts APA's concern. Because of difficulties in reestablishing the Science and Engineering Education Directorate at NSF after it was nearly abolished in 1981, the Administration is deferring $31.4 million of the $87 million appropriated for Fiscal 1985 into Fiscal 1986. This is the third consecutive year in which NSF has not been able to expend a significant portion of the funds appropriated for science education activities. APA urges the Committee to express its strong support for the full funding of these activities at NSF. Perhaps Fiscal 1986 will mark a science and engineering education renaissance at NSF. Certainly there is sufficient national need in this area and no dearth of high quality proposals worthy of support.

Again, thank you for the opportunity to submit this statement. For your information, following are a few examples of the contributions being made by the behavioral sciences.

- Today, we routinely employ survey research methodology in studies of the American economy; studies that business uses to make critical investment decisions, that the government uses to predict future revenues and reaction to potential alternative policy strategies, and that innovators use to assess the market potential for new products. This methodology rests on accumulative scientific efforts going back to the 1920's relating to attitude measurement and statistical sampling techniques.

- Human factors research in the behavioral sciences is routinely employed in American business and around the world. Examples are numerous, ranging from the layout of control rooms in nuclear reactors, to the design of flight panels in airplanes, in which the cockpit design has been based on fundamental studies of eye-hand coordination, as well as a large number of studies in basic production units on the shop floor. Such studies contribute to human safety, to productivity, and to innovation.

- Behavioral and social sciences have contributed directly to the management of the research and development process in other sciences. Existing literature has been directly related to the composition of research teams, the organizational structure of research organizations, and the relationship of R&D to other functions of a business firm, such as marketing. In some of the more innovative and productive American firms this knowledge is used routinely to guide research processes, often with direct increases in research productivity.

- The management structure and processes of American industry are often based on straight-forward behavioral science research. This research includes studies of the relationship of morale and employee satisfaction to productivity, the effects of employee participation in decision-making on productivity, the nature of resistance to change of management practices, employee profit-sharing plans, and the relationship of styles of leadership to group productivity.

- The potential of the behavioral sciences to contribute to the country's adjustment to rapidly changing technologies is also an area of great potential. As one example of the interplay between technology and human behavior, consider the problem of energy use. The development of energy sources and the refinement of techniques of production of energy are clearly problems for the engineering and physical sciences. However, the patterns of use of energy are almost entirely a question of human attitudes and behavior. Here conservation rests on such simple behaviors as turning a switch on or off, monitoring one's own behavior in such actions as turning up the thermostat in the summer and down in the winter, and the acceptance and/or purchase of alternative modes of supply.

- A recent report by the Surgeon General titled, "Healthy People" examines the 10 leading causes of death in the United States and concludes that seven of these are in large part behaviorally determined and could be substantially reduced by changing behaviors. This means changing the habits of individuals, including those related to diet, exercise, dental habits, smoking and drinking. The beginnings of important research on these topics can be traced back 35 years in the behavioral sciences to research on the change of dietary habits during the Second World War.

American Chemical Society

OFFICE OF THE
PRESIDENT

Ellis K. Fields
President-Elect, 1984
President, 1985
Immediate Past President, 1986

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April 22, 1985

The Honorable Orrin G. Hatch, Chairman
Committee on Labor and
Human Resources
United States Senate
Washington, D.C. 20510

Dear Senator Hatch:

The American Chemical Society welcomes this opportunity to present its views on the proposed FY 1986 budget for the National Science Foundation. Our comments focus on the NSF Chemistry Division, instrumentation, facilities, the Directorate for Science and Engineering Education, and the Directorate for Scientific, Technological, and International Affairs.

NSF CHEMISTRY DIVISION

The American Chemical Society urges that increased funding for chemical research be given a high priority in the deliberations of the Committee. In proportion to its contribution to the economy, chemistry has been and is currently underfunded.

Chemistry is entering a new era of productive inquiry as a result of advances in the understanding of the elemental steps of chemical change, and the existence of powerful instrumental techniques. The February 22, 1985 issue of Science magazine is devoted to exciting areas of chemistry which are indicative of this potential. However, chemistry's contribution to the Nation will not be fully realized unless the base funding support for the chemical sciences is increased and this increase is sustained.

Chemistry is a fundamental, central discipline from which many other sciences flow. The chemical sciences have been instrumental in the development of U.S. society, and they likewise will play a significant role in our Nation's future. These sciences are not only the backbone of today's chemical and allied products industries, but they also underlie the high technology industries, such as computers, electronics, robotics, and biotechnology. An estimated forty percent of the U.S. GNP is derived from the chemical sciences if food production and energy technology are taken into account. The chemical industry's shipments abroad yielded a trade surplus that averaged $10.6 billion per year from 1979-1983, making the U.S. chemical and related products industry a strong international competitor. Advances in these industries, and subsequent scientific and technological leadership by the U.S., will depend upon continued support of research in the basic chemical sciences as well as experienced personnel trained in the chemical and allied sciences.

While the Chemistry Division is the major source of funds for basic chemical research at NSF, other Divisions of the Foundation support related activities. The following remarks will be limited to the Chemistry Division, but these comments, in principle, could be extended to all NSF funding for the chemical sciences.

The NSF FY 1986 budget request for the Chemistry Division is 7.0 percent above the FY 1985 current plan. However, in order to address the significance of the proposed budget, the real magnitude of the increase needs to be examined in relation to prior funding patterns and future growth potential. It is important to recognize that although we are in a time of budget austerity, we must not lose opportunities for scientific advancement. These opportunities are available to us in the subfields of chemistry and in interdisciplinary research involving chemistry.

The FY 1986 budget is best understood if placed in a historical context. The funding history of the Chemistry Division in current and constant dollars is presented in Appendix I. Budget appropriations for basic research in chemistry have increased 2.5 times during the period 1973 to 1985. However, in estimated constant 1972 dollars, this increase represents an uneven growth pattern in funding of the Division which averages out to only a four percent annual increase. These figures indicate that basic chemical research has simply maintained a marginal growth when inflation is taken into consideration during this period. Maintenance or even low-level growth is insufficient when considering the contributions that the chemical sciences have made and will make to American society.

In the ACS analysis of the FY 1985 and 1986 budgets for the Chemistry Division, we have subtracted out the amounts earmarked for the two new initiatives--Chemistry of Life Processes and Materials Chemistry. This calculation indicates that the costs of the new program initiatives have been partly absorbed by the established subactivities of the Chemistry Division [Appendix II]. The Division will continue to deny high quality proposals in these established areas because of insufficient funds. Since the number of investigators receiving scientific research project support will remain at approximately 875, these new initiatives will make funding decisions more difficult starting in FY 1985.

Broad support for basic research across subfields is vital to the advancement of chemistry since it is impossible to predict where discoveries will occur. The consequence of not pursuing all good research translates into lost opportunities that in the long-term will be detrimental to the health of science and to the economy as well. Moreover, support by NSF of basic research is important to the health of chemistry as a discipline, particularly at academic institutions since the Chemistry Division in FY 1984 provided forty-one percent of the federal support for basic chemical research performed at universities and colleges.

The ACS favors setting research priorities and understands the need to cut back programs in order to reduce the federal budget deficit. However, the Society believes that the proposed funding level for the NSF is by no means the optimum. The opportunities before us in the chemical sciences would justify--even in a time of fiscal restraint--a far larger amount than is proposed.

Other scientific organizations have recognized the importance to the Nation of supporting promising chemical research areas. The National Academy of Sciences panel, which briefed the Office of Science and Technology Policy on chemistry in 1983, noted three such research areas in which a substantial infusion of federal funding would allow the exploration of new territory on the cutting edge of chemical science. These frontiers are: (1) chemical reactivity, (2) chemical catalysis, and (3) chemistry of life processes.

Only one of these areas, chemistry of life processes, has been targeted for specific NSF funding. The chemistry of life processes involves the application of basic chemistry techniques and principles to the solution of molecular life processes. Failure to fund sufficient research on the chemical aspects of biology could cost the U.S. its leadership in biotechnology and applied biology.

The NAS panel suggested that the chemistry of life processes be funded at a level of $25 million per year, with $10 million of this yearly amount available as grants. NSF funding for the Chemistry of Life Processes initiative is significantly below these recommended amounts. This means that many excellent research proposals in this emerging area will be inadequately funded or will not be supported at all.

In the Society's view, NSF plays a key role in ensuring the exploration of opportunities in basic chemical research in areas that are not pursued by the mission agencies. The Society believes that NSF cannot adequately perform this function within the constraints of the proposed FY 1986 budget. Consequently, ACS urges that funding for chemical research be given a high priority in the Foundation's FY 1986 budget.

INSTRUMENTATION

Achieving progress in the research areas receiving Foundation support depends on access to modern instrumentation. The survey conducted in 1982 by the ACS Committee on Science--"Instrumentation Needs of Academic Departments of Chemistry"--found that the average age of the instrumentation in U.S. chemistry departments was between eight and nine years [Appendix III]. In the experience of laboratory managers, retaining most instrumentation beyond seven or eight years is unwise. Given new developments in the field, instruments continuously become scientifically and technologically obsolete. The ACS survey results also indicated that fifteen percent of the equipment at smaller chemistry departments, and nine percent at major ones, was not fully operational in 1982. Therefore, given the age of the equipment, maintenance becomes an increasing problem.

The ability of chemists in academe to conduct research at the cutting edge of science is limited by the age and condition of their equipment. The ACS estimated that the one hundred major U.S. chemistry departments would need

$83.2 million for instrument purchases; the 470 smaller chemistry departments would need $65.5 million. The Society projected that with the addition of maintenance, technical support, and other ancillary costs, $500 million may be required to update and maintain equipment in a manner necessary to ensure progress in chemical research. The need, as estimated by the ACS study, is so great that both private sources and government programs must be utilized to address this problem.

The ACS is aware of the National Science Foundation's efforts to survey the need for and to fund instrumentation purchases. The Society especially commends the Foundation for assisting both research and undergraduate institutions in this area.

The ACS Office of Science Policy Analysis recently conducted a survey of all the current federal programs funding instrumentation purchases. As a result of the survey, the Society noted that federal program managers were not always aware of the working details of federal instrumentation programs other than their own. The implications of this situation are that, without an exchange of experiences and information, designing the best possible instrumentation program is a difficult, if not impossible task. The magnitude of the instrumentation problem for chemistry and other disciplines is so great that a more coordinated effort is necessary. The American Chemical Society strongly urges the Foundation to strengthen the interactions of the Interagency Working Group on Research Instrumentation so that governmental efforts in this crucial area could be made more efficient and cost-effective.

The American Chemical Society also supports the NSF's continuing commitment to increase access to supercomputers for academic research scientists and engineers. In 1984 the ACS Task Force on Large-Scale Computing completed a review of the kinds of critical chemical research problems that can be studied within a reasonable amount of time only with the use of a supercomputer. The Task Force concluded that supercomputers are an important component in sustaining the health of chemistry.

FACILITIES

In the past, campus "bricks and mortar" has been the responsibility of the public and private sectors. Academic institutions have obtained funding from a variety of sources--alumni funds, corporate grants, foundation grants, and federal government awards. The American Chemical Society believes this should be the continued method of obtaining facilities funding. No one should expect the federal government to solve single-handedly the facilities problem.

The exact magnitude of the facilities problem is not known, but there is a large and growing recognition of the need for funds to build and restore scientific research and education facilities. The ACS recommends that the NSF assess the country's current and projected need for new or renovated scientific facilities. Once such a nationwide assessment has been done, it can serve as a guideline for the consideration of future requests. The National Science Foundation already administers the data collection for instrumentation needs at universities. A similar data base should be assembled and maintained to assess future needs for university scientific facilities.

Although it is difficult to determine the scope of the facilities problem, it needs to be addressed now. One less costly method of dealing with the immediate problems in this area would be to initiate a renovation program rather than fund new starts for R&D and education facilities. Renovation funds should be used for modernizing the necessary safety features, such as fume hoods, needed in both research and teaching laboratories. The American Chemical Society urges that a renovation program be considered for funding in the FY 1987 NSF budget to address the problem of deterioration and obsolescence of existing facilities. Further, the Society endorses some form of merit-based review for such a federal renovation program.

In this time of attempting to control and reduce federal budget deficits, the university community needs to acknowledge and endorse merit-based review as a proven mechanism for and an essential component of choosing high quality projects. In the mid-1970's to early 1980's, the merit-based review process received close scrutiny and only minor changes. Currently, this process is still the most equitable way of guaranteeing careful scrutiny of and excellence in federally-funded basic research projects while assuring the best use of scarce federal funds. Consequently, ACS recommends that some form of merit-based review be established to select the highest quality facility projects.

SCIENCE AND ENGINEERING EDUCATION

The American Chemical Society supports the overall goals of the NSF Directorate for Science and Engineering Education and stands ready to offer its assistance. Specifically, the ACS commends the Directorate for emphasizing the science and mathematics taught in the middle and elementary schools of the U.S. The ACS recognizes good teaching at these levels to be of crucial importance to the development of a scientifically-informed citizenry, and the Society has established a Prehigh School Science Office to work with other concerned groups and associations on the many problems in this area.

The need to support precollege education in science and mathematics has been clearly recognized in a series of reports produced by a number of prominent national commissions. The ACS's own "Tomorrow" report published in April 1984 explicitly enumerates the Society's concern for adequate support of both teacher preservice and inservice training and for the development of new materials for grades K through 12 science education [Appendix IV]. Regrettably, it is in these two areas that the Directorate is, in effect, "losing" funds through the budget deferral process. The ACS is sympathetic to the management concerns of the Directorate, but deplores the need to defer funds from year-to-year. The Society is confident that the Directorate will continue its status as the lead agency in the area of science, mathematics, and engineering education. In order for the Directorate to accomplish this, ACS recommends that: the FY 1985 current plan of $82.0 million be set as the base for the Directorate's FY 1986 budget and that the $31.5 million in deferred funds be returned to the Directorate budget. This additional support should be allocated to the Materials Development and Research subactivity and the Teacher Enhancement and Informal Science Education subactivities, increasing their allotments to $38.4 and $40.8 million, respectively. Our recommendation is that the overall FY 1986 budget of the Directorate for Science and Engineering Education be set at $113.5 million. In making this recommendation, the ACS intends that new money be added to the $31.5 million deferral in order not to reduce support for research in the disciplines funded by NSF.

The American Chemical Society recognizes, as does the Directorate, the importance of working in partnership with others and of establishing communication networks in support of excellence in science and engineering education for all levels of students. The ACS stands ready to give its support to the Directorate in expanding and maintaining such networks.

Finally, the ACS is pleased with the continued support of Presidential Young Investigator Awards. The NSF should be applauded for its continued support of Graduate Research Fellowships through its Research Career Development subactivity. However, the American Chemical Society does recommend that some portion of these funds be awarded directly to institutions of higher learning as competitive block grants for support of their own graduate fellowship programs. The effect of currently awarding all funds to individual students is to channel recipients of these portable fellowships into a few prestigious institutions, resulting in an inequitable distribution of funds and a weakening of promising research programs at other universities. Science only thrives through the creative interplay of diverse ideas as expressed through research conducted at a variety of institutions.

SCIENTIFIC, TECHNOLOGICAL, AND INTERNATIONAL AFFAIRS

At a time when international scientific cooperation is an avenue to world peace and economic development, cuts in the International Cooperative Scientific Activities program in the Directorate for Scientific, Technological, and International Affairs (STIA) are viewed by the ACS as counterproductive. The American Chemical Society believes it is very much in the government's interest to provide support for activities such as attendance at international scientific and engineering conferences, formation of cooperative research and development projects, provision for scientific journals, and reciprocal lecture tours. Support for these activities is the responsiblity of a number of federal departments and agencies, but NSF should have primary responsibility, especially in areas involving basic research.

The ACS applauds the Foundation's continued priority under STIA for research support for undergraduate institutions, women, and minority scientists. The American Chemical Society is pleased that funding has doubled for Research Opportunities for Women and that the program is concerned with career reentry.

The National Charter of the American Chemical Society imposes an obligation upon the Society to provide advice to the government in matters of national concern related to its areas of competence. One of the objectives set forth in the ACS Federal Charter is the promotion of research and the advancement of education. With this objective in mind, we hope that our comments will be useful to the Committee in its deliberations on the FY 1986 budget of the National Science Foundation.

Sincerely yours,

Ellis K. Fields

Ellis K. Fields

Appendices (4)

APPENDIX I

NSF
Chemistry Division Appropriations
History 1973-1986
(000 Omitted from Dollar Amounts)

Fiscal Year	Actual/Proposed	GNP Deflator	Constant (1972) Dollars
1973	$25,081	1.044	$24,024
1974	26,645	1.125	23,684
1975	32,728	1.246	26,266
1976	34,650	1.332	26,014
1977	40,226	1.424	28,249
1978	43,050	1.520	28,322
1979	45,230	1.651	27,396
1980	51,451	1.776	28,970
1981	57,622	1.953	29,504
1982	61,356	2.093	29,315
1983	67,628	2.176	31,079
1984	79,427	2.259	35,160
1985	87,400 (proposed)	2.341*	37,334
1986	93,500 (proposed)	2.443*	38,273

*The GNP deflators for 1985 and 1986 are estimates

SOURCE: National Science Foundation

Prepared by: American Chemical Society

NATIONAL SCIENCE FOUNDATION
CHEMISTRY DIVISION

(000 Omitted from Dollar Amounts)

Program Title	FY 1984 Actual	FY 1985 Current Plan	FY 1986 Proposed	% Increase 1985-1986
Chemistry of Life Processes [a]	0	$ 2,000	$ 3,500	75.0%
Materials Chemistry Initiative [b]	0	0	$ 900	100.0%
Remaining Chemistry Division	$79,427	$85,400	$89,100	4.3%
TOTAL, Chemistry Division	$79,427	$87,400	$93,500	7.0%

[a] Funding from the Biological, Behavioral, and Social Sciences Directorate for the Chemistry of Life Processes:
FY 1985, $1.5 million;
FY 1986, $1.0 million (estimate).

[b] Funding from the Materials Research Division for the Materials Chemistry Initiative:
FY 1986, $0.9 million (estimate).

SOURCE: National Science Foundation

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

STATEMENT

OF

DONALD G. WEINERT, P.E.

ON BEHALF OF THE

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

ON THE

NATIONAL SCIENCE FOUNDATION AUTHORIZATION ACT

S. 801

LABOR AND HUMAN RESOURCES COMMITTEE

U.S. SENATE

APRIL 30, 1985

1420 KING STREET ■ ALEXANDRIA, VIRGINIA 22314 ■ 703/684-2800

Chairman Hatch and Members of the Committee:

I am pleased to submit our statement on the FY '86 National Science Foundation Authorization Bill S. 801. I am Donald G. Weinert, P.E., Executive Director of the National Society of Professional Engineers (NSPE). NSPE is a professional engineering society, representing over 75,000 engineers of all disciplines nationwide. Our members are organized into 50 state societies and over 500 local chapters, and work in industry, education, private practice, construction and government.

We are pleased to have this opportunity to express our views on the National Science Foundation Authorization Act, S. 801. Over the past several years we have participated in the debate over the proper Federal role in fostering enhanced technological competitiveness, and strongly believe that the National Science Foundation plays a critical role. In fact, we have been leading advocates of strengthening the NSF's commitment to fundamental engineering research and education as the most appropriate means to maintain an adequate base of research and talent, both of which are essential to technological progress. The NSF has demonstrated that while preserving excellence and integrity in basic science, it can and will serve equally well for engineering education and research. We applaud the current direction of the NSF's Engineering Directorate, and appreciate the support and guidance this Committee has provided. Erich Bloch and Nam Suh have already made some promising changes in the Directorate, and are leading the Foundation into a new era of strength in both science and engineering.

Before commenting on the budget, we would like to express our strong belief that legislation to add an engineering mission statement to the NSF Charter is extremely important. We commend Senator Hatch and Senator Quayle for their efforts to pass this legislation last year, and hope this Committee will be able to provide the leadership necessary to pass the bill into law this session. We are especially pleased to see that this year the Administration has requested the engineering mission language, and commend you for including it in S. 801.

While an improved structure and mission statement will clearly not solve the engineering community's need for research and education suport, it will insure that engineering programs are conducted in the proper environment. Without a supportive mission and structure, the future strength of the Foundation's engineering programs is uncertain and subject to the whims of the time. While the current administration's firm support is appreciated and encouraging, it is insufficient to guarantee sustained support over the long term. As we all know, roller-coasting funding thwarts technological process like nothing else. I hope we will be able to pass an engineering amendment to the Organic Act into law this year, and again offer you our full support in developing a workable plan.

The National Science Foundation plays a unique role among Federal agencies. There is no other government agency which has the responsibility to support civilian, academically-based research in a manner that has such a dramatic and positive influence on the technical talent this country educates. Research and talent are both essential ingredients for innovation and technological competitiveness, and the NSF's budget should be examined from this perspective rather than solely in the sphere of science policy. In the current climate of increased international competition, we can no longer afford to assume that technological pre-eminence is automatically American. The role that the National Science Foundation plays must not be underestimated.

Particularly in engineering, weaknesses in the quality of engineering education threaten the ability of our country to improve our technological posture. The laboratory equipment used to train young engineering students is deplorable. Nationally, a 1982 study conducted by the National Society of

Professional Engineers found that instructional equipment needs, not including computers, totalled nearly $2.2 billion. Recently, a colleague of mine remarked that his students would never see the lab equipment they are using again, except perhaps in the Smithsonian.

To compound the problem, engineering schools are experiencing severe faculty shortages at just the same time student enrollments are skyrocketing. While engineering enrollments rose 115 percent over the last decade, engineering faculty grew by a mere 14 percent. The latest figures indicate an 8.5 percent engineering faculty vacancy rate, which grows to 23 percent if one considers student/faculty ratios associated with quality education. Since 1975, these ratios have risen from 17.0 to 23.0 in engineering schools, resulting in class sizes far too large and an environment not conducive to learning by any standard.

An equally compelling but less well-documented problem lies in the need for renovation and construction of facilities. The attempts of some institutions to bypass the peer review system in order to receive Federal funds for facilities is an indication of the severity of this problem. While I cannot suggest a solution at this time, I note that your colleagues on the House Science and Technology Committee have recommended that the Foundation conduct an analysis of university research facilities needs. This study will provide the necessary information to proceed with solutions.

These problems are clearly too deep for any one sector to solve alone. Comprehensive partnerships involving academe, industry and government are the only way we can combat the weaknesses in engineering education that have been growing since the Apollo era ended nearly two decades ago. We can no longer afford to underinvest in engineering research and talent, and I commend the Administration for having the foresight to recommend modest growth in the

FY '86 budget for the National Science Foundation. Without attention to our bright, young minds studying engineering and science, whatever gains we make today will suffer from a lack of talent tomorrow. While we all recognize the severity of the Federal deficit and the importance of seeking an austere budget, we strongly believe that the FY '86 budget proposals for the NSF represent a sound investment in the future of America, rather than a drain on the Treasury. We urge you to fully authorize the FY '86 NSF budget at the level recommended by the President.

In particular, we fully support the recommended $170 million budget for the Engineering Directorate, and point out that it represents just 14 percent of the total NSF budget. Given the clear need for a healthy engineering research and education system, it is reasonable for the Foundation to assign priority to strengthening the Engineering Directorate. The steady growth engineering is now experiencing follows years of underfunding and inattention.

We would like to comment specifically on the programs that relate to engineering. First, we want to reassure the Subcommittee that the reorganization of the Engineering Directorate is fully supported by NSPE. We feel strongly that by organizing the Directorate along functional rather than discipline lines, current weaknesses in engineering research will be more effectively addressed. The character of engineering research is changing rapidly, and universities appreciate the impetus provided by this move to respond to the realities of engineering practice. While industry demands extensive interdisciplinary, team approaches, the vast majority of engineering schools do not currently have the capability of training students in this manner. Further, in emerging areas such as manufacturing and biotechnology, there are few engineering programs to respond to important national needs.

Not only does this force industry to retrain recent graduates, but it minimizes the interest and enthusiasm that could be generated in students by invigorating educational preparation.

The National Science Foundation has responded well to these problems. The newly established Cross-disciplinary Research Center (ERC) programs provides just the type of research and training opportunity that engineering schools currently lack. By establishing centers of excellence in specific areas that require cross-disciplinary investigation and experimentation, students and faculty will have a chance to explore problems in a manner that not only will yield critical research results, but will provide essential training. Integrating the skills and knowledge of a university's existing resources with new tools will enable us to prepare students for the challenges of tomorrow. It is especially important to note that this program is designed to benefit undergraduates as well as advanced degree candidates, since unlike the science disciplines, a bachelors degree is the entry level degree in engineering. For too long, the NSF has not focused on this important characteristic of the engineering profession.

The ERC program is a welcome addition to the scope of NSF programs. In its first year this program generated responses from 142 or roughly half of the nation's engineering schools. Yet, with just $10 million, only six Centers could be funded. While the NSF certainly should not be expected to support every good proposal, it should be able to address well-documented, important national needs in a more responsive manner. The $25 million funding level requested by the Administration is the absolute minimal support that can sustain this exciting program. I hope that in attempting to balance fiscal austerity with program needs, the Engineering Research Center program will remain a top priority. I fully support the testimony given to this effect by Mr. Bloch and Dr. Keyworth, and hope you will follow their guidance.

On another topic, I know that this Committee shares our concern for precollege education. However, while we are anxious to see the Founation's precollege programs advance, we respect NSF's judgment in deferring funds from the FY '85 budget to the FY '86 budget. We urge you not to recommend an increase in the budget of the Science and Engineering Education Directorate. As you know, Mr. Bloch and the entire Foundation staff have developed a delicately balanced budget, and I hope we can help maintain the program priorities and funding levels that have been identified.

In sum, I thank the Committee for this opportunity to share our views on the National Science Foundation budget. We strongly support S. 801, and urge you to fully authorize the FY '86 budget. We commend the Foundation for developing a sound budget plan for engineering, in particular, and hope you will support the NSF's efforts to strengthen the engineering research and education base in America. By doing so, we will be building a future of world technological leadership. We look forward to working with the Committee on this and related matters.

The MATHEMATICAL ASSOCIATION of AMERICA
INCORPORATED

Lynn Arthur Steen
President

Department of Mathematics
St. Olaf College
Northfield, Minnesota 55057
507 663-3114

April 26, 1985

Senator Orrin Hatch, Chairman
Committee on Labor and Human Resources
United States Senate
Washington, D.C. 20510

Dear Senator Hatch:

I enclose a statement expressing my concern, and that of the Mathematical Association of America, over the Science Education budget of the National Science Foundation.

If you wish further elaboration on any of the issues mentioned in this statement, I would be glad to provide it.

Sincerely,

Lynn A Steen

Lynn Arthur Steen
President

LAS:mkp
enc.

April 25, 1985

Statement on N.S.F. Support for Science Education

Lynn Arthur Steen, President
Mathematical Association of America
St. Olaf College, Northfield, Minn.

As the national debate on education has unfolded in recent years, one theme has recurred within the scientific and mathematical communities--that research scientists have largely abandoned their responsibilities for leadership in education. This concern has led the Conference Board of Mathematical Sciences to bring together mathematics teachers and mathematics researchers for the common purpose of improving mathematics education.

This process takes time, but is now on the verge of leading to a significant initiative for a national Board on Mathematical Sciences Education under the auspices of the National Academy of Sciences. Other cooperative but more specialized efforts are moving in parallel, to address problems of curriculum redefinition, teacher training materials, technology, and testing.

I am concerned that just as the mathematical community is prepared to respond to the national concern about mathematics education, short-sighted budget decisions may once again--as they did several years ago--undermine the whole endeavor. Education requires consistent, long-range support related to long-range objectives.

I speak for the Mathematical Association of America (MAA), an organization of nearly 20,000 college and university mathematice teachers. We are the principal organization linking the teaching and research communities in the mathematical sciences. The focus of our work is collegiate mathematics--to prepare students for precollege teaching, for post-graduate study and research, and for business and industrial careers.

We are concerned with two aspects of the proposed N.S.F. Science and Engineering Education budget: the severe reduction in baseline for precollege activities, and the insignificant allocation to collegiate science and mathematics education. I'll address each of these two issues in turn.

Precollege Mathematics Education

What happens in mathematics education at the precollege level sets the level of science, engineering and mathematics for the nation. If students arrive in college unprepared in mathematics, they cannot continue in science or in engineering or in most other professional degree programs without costly and usually ineffective remedial work. The proper place to learn school mathematics is in school, not in college.

As part of the development effort leading to the proposal for the Board of Mathematical Science Education, we identified dozens of projects to improve school mathematics that are just now becoming ready for funding. Some have been submitted within the past few months; others will be submitted in the near future. These projects represent coalitions of individuals in schools, universities, and professional societies; they are the best hope our nation has for improving school mathematics.

These proposals in mathematics alone can easily consume more than the $19 million baseline proposed for precollege education in the N.S.F. budget. Surely there will be corresponding national projects in science and technology education of equal scope. If the FY86 NSF baseline for precollege education is reduced to $19 million, anticipation of similar absurdly low levels in the future will dry up all these promising projects. You can't simply turn good projects on and off like water in a faucet. For the long term health of precollege science and mathematics education, I urge you to maintain for FY86 and beyond a reasonable baseline for precollege projects.

Collegiate Education

Mathematics education is a continuous, sequential process from primary school through graduate school in which changes in any part have significant consequences throughout the entire system. Undergraduate mathematics is a major conduit for the education of scientific and business leaders. Some college mathematics or statistics is required for virtually every professional degree program. Yet mathematics is changing dramatically--in content, in scope, and in application. Mathematics is not just being applied, but is being continually created.

As mathematics needs to be continually created to provide new tools for science and industry, so the undergraduate curriculum needs to be continually renewed to reflect the changing nature of mathematical practice and scholarship. Yet the limited resources of undergraduate mathematics departments are now thinly spread over an enormous variety of elementary courses. Collegiate mathematics must provide courses for future scientists, programs for prospective elementary and secondary school teachers, remedial courses for those entering college unprepared in mathematics, general education courses for students not majoring in a quantitative discipline, strong majors for those intending to enter graduate school, and a variety of service courses ranging from elementary statistics to advanced operations research. Moreover, in most institutions, mathematicians must also teach computer programming and elementary computer science. The strain of meeting these diverse obligations leaves virtually no time or energy for the in-depth study necessary to renew faculty initiative or to develop innovative programs.

Signs of strain are everywhere. Nearly two-thirds of college freshmen are not prepared to study college mathematics, being required instead to take or retake some parts of school mathematics. During the last 15 years, total undergraduate enrollments in mathematics have doubled, but enrollments in advanced courses have been cut in half. Now fewer than 5% of undergraduate enrollments are in post-calculus courses.

Bachelors, masters and Ph.D. degrees in mathematics have declined by over 50%. Fewer than 60% of the Ph.D. degrees granted by American universities in the mathematical sciences goes to a U. S. citizen. Projected faculty retirements coupled with vigorous demand for mathematical scientists from the nation's supercomputing endeavor virtually insure that the United

States is facing a serious shortage of mathematicians just as demand for mathematical knowledge is at record levels.

Modern mathematics is repeatedly being pressed into service by modern science. Proper curricular response will multiply the linkages between mathematics and other disciplines. No longer are the concepts of mathematics used only in physics and engineering. Now they can be found in linguistics, medicine, psychology, agriculture, music--virtually every subject taught in an undergraduate curriculum. The connections between mathematics and other subjects are often mediated by computer science, but real mathematics always lurks immedately beneath the surface.

For the sake of our students, we must revitalize collegiate mathematics by infusing the undergraduate years with the spirit of contemporary mathematical activity. We must encourage mathematics faculty to become active users of sophisticated computers. We must support exemplary programs that encourage students to major in mathematics. We must encourage creativity in developing programs for prospective school teachers as well as for prospective scientists. We must recognize that undergraduate mathematics has become a laboratory science, with computer methods required in virtually every course in the curriculum. And, perhaps most of all, we must encourage and support those who provide effective courses in "mathematical literacy" for future lawyers, politicians, and citizens.

For the rest of this decade mathematics departments will continue under great stress. We live in the shadow of computer science, the glamour stock of academia. In contrast to computing, mathematics appears as a cerebral abstraction, isolated from reality. Yet industry is hiring mathematics graduates as never before; society is pressuring the schools to stress mathematics; and the scientific research community has endorsed mathematics as one of the priority areas for support in years ahead.

With declining numbers of students entering colleges, demand for mathematically trained individuals will greatly exceed supply. If we do not encourage renewal in collegiate mathematics, we run the risk of shortchanging virtually all sophisticated scientific research and business innovation. It is vitally important that the N. S. F. budget provide adequate baseline support for collegiate science and mathematics *both* for instrumentation and for curricular renewal. $5 million is far too low even to meet the legitimate needs of scientific instrumentation, much less to allow for curricular renewal.

In summary, I urge that you budget adequate baseline support both for precollege education in science and mathematics, and for collegiate programs of both instrumentation and curricular renewal. Moreover, the baseline should be set and maintained from year to year, to encourage stable programs of high quality.

AMERICAN INSTITUTE
of BIOLOGICAL SCIENCES

730 11th St., N.W.
Washington, D.C. 20001

Founded 1947

STATEMENT OF THE AIBS PUBLIC RESPONSIBILITIES COMMITTEE ON NATIONAL SCIENCE FOUNDATION AUTHORIZATIONS

TO THE

SENATE COMMITTEE ON LABOR AND HUMAN RESOURCES

MAY 6, 1985

The American Institute of Biological Sciences is a national federation of 40 academic societies and research laboratories and represents more than 70,000 life scientists. The AIBS Public Responsibilities Committee advises the Institute on matters concerning legislation, government regulation and public policy. The Committee submits the following comments and suggestions regarding the legislation to reauthorize the National Science Foundation.

As a federation of biological societies, AIBS follows closely the authorizations, appropriations and program priorities of the NSF's

Biological, Behavioral and Social Sciences Directorate, the Science and Engineering Education Directorate, the Astronomical, Atmospheric, Earth and Ocean Sciences Directorate, and various international, incentive and instrumentation programs. We are pleased to note the level of support the administration is recommending for many of the research and instrumentation programs at NSF. However, we have some concerns about recent policy directions and funding deferrals.

Presidential Science Advisor George Keyworth II made several comments about the biological sciences at a February 5th hearing on the Administration's FY 1986 science budget held by the House of Representatives' Committee on Science and Technology. Dr. Keyworth remarked, "The biological sciences stand on the brink of understanding that I can only liken to the brink that Einstein saw for physics in 1905. So it's fair to ask if we are developing the science base we need to reap the benefits that we foresee." The AIBS Public Responsibilities Committee believes the 8% increase in the proposed budget for the BBS Directorate at NSF is an action to enhance the science base referred to by Dr. Keyworth and hopes the Congress will support this increase.

Dr. Keyworth also testified, "It wouldn't surprise me to find newly industrialized nations looking for opportunities in science and technology to develop strong capabilities to challenge us in biotechnology. We seem to be giving far too little attention to protecting and capitalizing on our long-term investment in life sciences by broadening the disciplinary base."

AIBS, again, believes the NSF budget request for a 13% increase in research and cross-disciplinary training in biotechnology reflects a serious effort to maintain U.S. leadership in this field.

We recognize the value of large scale projects, such as the new engineering and super computer centers and the proposed high energy project. However, we encourage NSF and the Congress to make certain that these new initiatives do not erode funding for competitive awards to individual researchers that have long been given priority at the Foundation. Recent efforts to increase the size and duration of individual grants must be sustained in order to provide stability in our nation's research activities.

In FY 1985, $82 million was appropriated for science and engineering education at NSF. For FY 1986, the request is $50.55 million, although the actual budget is estimated at $82 million due to a $31.45 million carry-over in unspent funds from FY 1985. We hope the Committee will urge NSF to efficiently plan and ensure that the Directorate has sufficient staff to spend the entire $82 million during FY 1986. In addition, we encourage the Committee to hold oversight hearings later this year to make certain that the Science and Engineering Education Directorate is spending its appropriation at a rate consistent with Congressional intent. We feel the Directorate is on a firm footing with its new Assistant Director and are aware that planning for program priorities and use of funds has been under way for several months. We hope that this improved organization will lead to support of projects that will significantly enhance science education and that support for young investigators, graduate and postdoctoral students through fellowships and other means will continue to grow. Increasing the stipend for graduate fellowships by approximately $2,000 to provide a total of approximately $13,000 would bring NSF's fellowship program more into line with support provided by other federal agencies and provide a greater incentive for students to pursue their research and educational goals.

Although Dr. Eric Bloch, Director of the National Science Foundation, has been consistent in his testimony before Congressional committees regarding NSF's intent to give priority to pre-college science education, we believe that to provide a continuum between high school and graduate level education, support must also be provided for undergraduate level instruction -- an area which now seems to be given lower priority. We are pleased that NSF proposes to continue its program of support for research at predominately undergraduate institutions and the College Science Instrumentation Program. However, we strongly believe NSF needs to meet the instructional equipment needs of all levels of education so that both young and older students can learn about and participate in new discoveries in science. We hope this support will be reflected in authorizing legislation.

A planned initiative for NSF to conduct a survey of research equipment and facilities was abandoned. We believe such a survey would be of significant value in directing a course of action to address needs to improve our reseach laboratories and should be commenced by NSF. Meeting our nation's needs for research equipment and facilities would further be injured by any

Congressional proposals to freeze NSF authorizations for FY 1986 at the FY 1985 level. Such a freeze would likely result in a $20 million reduction in funds for modernization of research equipment.

A special word needs to be said about science museums. These include arboretums, botanical gardens, zoological and marine parks, and natural science and historical museums. The educational activities of these museums have been supported by NSF's Science and Engineering Education Directorate. Special research projects conducted by museums have been supported by NSF's research directorates. Some museums maintain stocks of genetic materials ranging from actual organisms to plasm, seed banks and tissue cultures. There are no alternatives to these resources in maintaining our international leadership in recombinant biotechnology projects. Since NSF is a major source of support for the educational and research activities of our nation's science museums, the foundation's role in this regard needs to be recognized and strengthened.

In testimony before the committee on April 30, Dr. Bloch indicated that, in the past, the EVIST program (Ethics and Values in Science and Technology) had supported projects in a couple of selected areas, one of which is related to the biological sciences. NSF now plans to integrate the kinds of projects supported by EVIST into general NSF directorate programs, but continue to spend $1 million on such projects. The AIBS Committee believes NSF must develop an appropriate central information function that ensures that ethics and values projects, including those related to biological sciences and biotechnology are properly reviewed by peers and receive funding support. Since many ethical questions have arisen in the past couple of years concerning specific biotechnology research projects and environmental release of bioengineered organisms, we feel this is an important aspect of scientific investigation.

In the same manner, NSF intends to "mainstream" the women and minorities initiatives into the science directorates. While such a move strengthens the review of proposals by peers so that the best talent and projects are funded, similar oversight and information collection activities need to be conducted to make certain the focus that has been provided by separate programs is not lost. According to a 1980 survey reported by NSF (document no. 82-314, p. 86), women composed 13.12%, blacks 1.91%, Asians 2.6%, and other minorities .34% of all scientists and engineers in the U.S. We feel separate funding must be maintained for activities that enhance the career development of women and minorities and their contributions to science.

Following withdrawal of the U.S. from UNESCO, Dr. Keyworth indicated that international science activities formerly supported in that organization by U.S. funds and manpower would be continued by the science agencies of our government. However, except for a $2.7 million budget request for the State Department, there is no indication that any of these initiatives are being assumed by the agencies, and, in fact, NSF's budget for international programs, including International Cooperative Science Activities and International Scientific Organizations and Resources is $1.5 million below planned FY 85 expenditures. The assumption of responsibility for some of the scientific activities formerly supported within UNESCO would be reflected in a budget increase and explained in the text supporting the budget request. Concerns of all countries in such areas as ecology are interrelated. Failure to provide government funding for some of the scientific activities formerly supported within UNESCO might lead to discontinuation of important research that could not be resumed at a later date. We hope the Senate Committee will consider this factor when setting the authorization level for NSF's international programs.

In summary, we ask that the Senate Labor and Human Resources Committee authorize the National Science Foundation's programs at the budget level requested by the President, and consider the initiatives in this statement when addressing specific activities of the Foundation. We appreciate the opportunity to share our views as the Committee considers reauthorization legislation.

PUBLIC AND SCIENTIFIC AFFAIRS BOARD
AMERICAN SOCIETY FOR MICROBIOLOGY

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Washington, D.C. 20006
Telephone: (202) 822-9229

May 14, 1985

The Honorable Orrin G. Hatch
Chairman, Senate Committee on Labor and
Human Resources
SD-428 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Senator Hatch:

The Public and Scientific Affairs Board (PSAB) of the American Society for Microbiology (ASM) wishes to comment on the Fiscal Year (FY) 1986 budget for the National Science Foundation (NSF).

The ASM is the largest single biological life science organization in the world with an active membership of over 34,000. Many of these individuals are engaged in biological research and a sizable number are recipients of awards administered by the NSF. A large number of areas are represented in their interests, including molecular genetics, biotechnology, photosynthesis, nitrogen fixation, regulation of gene expression, immunology, and ecology. Our comments are directed primarily to funding for research and training conducted by the NSF Directorate for Biological, Behavioral and Social Sciences (BBS).

In a budget year when unusually intense efforts are being made to cut government spending in order to reduce the national deficit, it is unreasonable to expect substantial growth in the level of funding for the National Science Foundation. It should be noted, however, that the Administration proposed an increase in the total budget for NSF of $67 million, from $1.502 billion in FY 1985 to $1.569 billion in FY 1986, an overall increase of just 4.4% or approximately the same as the rate of inflation projected for 1986. Our analysis of the proposed NSF budget indicates that this very modest increase has not been applied uniformly to all areas of the budget. Choices have been made in order to strengthen new areas in engineering, cross-disciplinary research, biotechnology, and other areas such as mathematics and the social and economic sciences, where NSF has unique responsibilities. In general, we commend the selective approach taken by NSF and the choices made considering the tight budget, but find that not enough of an increase has been applied to research and training in biotechnology.

The National Science Board issued a recommendation in June 1984 requesting that the Director of NSF develop an expanded program in biotechnology, focusing on research and education in this burgeoning and economically important field. Also, the Board recommended that attention be paid to renewing aging instrumentation and research facilities. We support these new initiatives, and agree that the process of peer review should be the mechanism of identification of meritorious projects. The NSF FY 1986 budget request responded to these and other needs, providing impetus in several areas in spite of the constraints of a total budget figure that is advanced only modestly beyond 1985 levels. We recognize the budget problems and applaud the efforts being made to do as much as possible with as little as possible. Nevertheless, we wish to make some recommendations in areas that we believe deserve reasonable growth during this era of fiscal constraint.

With respect to training programs, we are concerned about the proposal to reduce the Presidential Young Investigator Program by 100 new awards. We believe that, for growth of the nation's science and technology, there is a need for trained scientists from many disciplines. Therefore, we strongly support this initiative at the original goal of 200 new investigators each year. We also recommend that the Graduate Research Fellowships Program continue to increase commensurate with real dollar increases beyond the level of inflation. A 10% increase in the total dollar commitment would bring the $27 million appropriated for FY 1985 to about $30 million in FY 1986. This level of support will allow for an increase of about 150 NSF Graduate Research Fellowships, instead of the proposed zero-dollar growth, resulting in a reduction of 40 fellowships in FY 1986.

The PSAB believes the biotechnology initiative deserves more tangible support than it will receive in the basic biological sciences in the proposed budget. It is difficult to identify the logic, in terms of budget category, of all funding that has been designated as supporting biotechnology. Also, it is difficult to know whether meritorious research designated in areas other than biotechnology, might not, in some cases, be supplanted by new programs. We believe highly meritorious research in all areas of the basic biological sciences should continue to be supported. Thus the initiative in biotechnology must not usurp other worthwhile areas of research. We are disappointed in the magnitude of the effect of the biotechnology initiative on the budgets of the basic biological research programs. Much of the research in the area of biotechnology will fall in the categories of molecular biosciences, cellular biosciences and biotic systems and resources within BBS. In the budget request, these three programs are increased only by 5 to 8%, not much more than inflation. Support for new areas of research in the field of biotechnology should not replace support for basic biological research but should be in addition to such support.

We are gratified to note that the FY 1984 and 1985 appropriations permit some progress in reversing the trend toward a steady decline in both the dollar value of successful grants and the proportion of successful grants in the molecular and cellular biosciences supported by BBS. Incremental increases for the biological sciences must be sustained in order to reach the point where a significant number of meritorious grants are funded at a level sufficient to carry out the proposed work. In spite of this laudable progress, NSF grants in the biological sciences continue to be too small and too few, compared with those of other federal agencies. For these reasons we recommend an increase of 13% for basic research in molecular and cellular biosciences and biotic systems and resources in FY 1986. The dollar amount to effect a real boost in biotechnology would be $11 million above the proposed increase.

Although it may be considered necessary to slow, reduce or phase out some programs in order to support others more vigorously, we disagree with the termination of the program in Alternate Biological Resources. One of the advances that is likely to be made through application of biotechnology is development of alternate sources of human and animal food in the form ot "biomass." We support restoration of the budget of $2.5 million to enable exploration of alternate solutions to the world's pressing problems of inadequate nutrition and starvation.

In summary, the PSAB supports the broad shape of the Administration's proposal for the NSF budget. We suggest, however, that reasonable increases in carefully targeted areas could generate an even greater effect in the arena of biotechnology research and in the training of young scientists. We believe that an appreciable effect could be achieved with relatively modest increases in only a few budget categories. Awarding a 13% increase to research programs in the areas of basic biological research would require an additional $11 million over the presently recommended increase. Awarding a 10% increase to the Graduate Research Fellowships Program would require $2.7 million. Restoration of the program in Alternate Biological Resources would require $2.5 million. Altogether, a total increment of $16.2 million over the Administration's requested level of support could spark new initiatives in biotechnology and would achieve a more balanced emphasis among each of the areas highlighted in the 1986 budget request, i.e. engineering, advanced scientific computing and biotechnology. The total cost of the increases we suggest constitutes only 1% of the total amount that has been requested for NSF for FY 1986.

We are discouraged by the recent action of the House to freeze the NSF budget in FY 1986 at the FY 1985 level of spending. Holding spending on NSF programs at the FY 1985 level, without an increase at least to keep pace with inflation, will have a stifling effect and will seriously erode benefits achieved by the 1984 and 1985 appropriations. We urge that the Administration's proposed increase for NSF be adopted as a minimum level to sustain the nation's investment in basic scientific research and training. The reasonable growth we propose will enable pursuit of new opportunities in biotechnology research and training and will assure America's world leadership in biotechnology. As indicated in the 1983 Office of Science and Technology Report on Commercial Biotechnology, the fragile competitive edge which the U.S. currently enjoys in biotechnology is no longer certain for the immediate future.

We appreciate the opportunity to submit these comments and would be pleased to assist you in any way possible during your deliberations on the NSF budget for FY 1986.

Sincerely,

H.O. Halvorson
Harlyn O. Halvorson, Ph.D.
Chairman, Public and Scientific Affairs Board, ASM

Monica Riley
Monica Riley, Ph.D.
Chairman, Committee on Molecular and Genetic Microbiology, PSAB

Association of American Universities

Office of Federal Relations

April 29, 1985

Senator Orrin G. Hatch
135 Senate Russell Office Building
U.S. Senate
Washington, DC 20510

Dear Senator Hatch:

I write on behalf of several higher education associations to request that our enclosed statement on the Fiscal Year 1986 Authorization for the National Science Foundation be made a part of the Committee's hearing record. We understand that the Committee will hold a hearing on April 30 to receive testimony from Mr. Bloch, Director of the Foundation.

This is a time of unprecedented international economic and technological competition. If we are to meet that challenge we must sustain our commitment to excellence in the two commodities that give us our competitive edge: talent and technology. We will do well not to further compromise our ability to conduct quality research and training programs in the sciences and engineering. We ask the Committee, therefore, to authorize the Foundation's research and education activities at the level requested by the President. The Foundation's budget request is well balanced and carefully designed to respond to the needs both for budget restraint and for targeted investments in key fields of science and engineering. A freeze at Fiscal Year 1985 levels will impose serious setbacks on many of the most important research initiatives, and it will send a discouraging signal to prospective young faculty and graduate students that our commitment to science, technology and advanced education is fragile.

We also ask that the Committee join with the Senate Commerce Committee and the House Committee on Science and Technology in authorizing the Foundation to develop a permanent analytical capability to document, analyze and report to the Congress on the research facilities needs of universities. Our statement provides our specific recommendation and explains the need for this new provision.

Suite 730 • One Dupont Circle • Washington, DC 20036 • 202/466-5030

We thank you and the Committee for your continuing support and leadership in behalf of the Foundation's research and education programs. Our associations stand ready to be of further assistance to you.

Sincerely,

John C. Crowley

John C. Crowley
Director of Federal Relations
for Science Research

JCC:flm

cc: Members of the Committee on Labor and Human Resources

STATEMENT

ON THE

FISCAL YEAR 1986 AUTHORIZATION

FOR THE

NATIONAL SCIENCE FOUNDATION

SUBMITTED TO

THE COMMITTEE ON LABOR AND HUMAN RESOURCES

UNITED STATES SENATE

IN BEHALF OF THE

ASSOCIATION OF AMERICAN UNIVERSITIES
NATIONAL ASSOCIATION OF STATE UNIVERSITIES AND LAND-GRANT COLLEGES
AMERICAN COUNCIL ON EDUCATION
ASSOCIATION OF GRADUATE SCHOOLS
COUNCIL OF GRADUATE SCHOOLS

APRIL 30, 1985

MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE,

THESE SEVERAL ASSOCIATIONS, ON BEHALF OF THE NATION'S UNIVERSITIES AND COLLEGES, APPRECIATE THE OPPORTUNITY TO SUBMIT THE FOLLOWING STATEMENT ON THE FISCAL YEAR 1986 AUTHORIZATION FOR THE NATIONAL SCIENCE FOUNDATION. WE URGE THE COMMITTEE TO AUTHORIZE THE NSF FISCAL YEAR 1986 BUDGET AT THE LEVEL REQUESTED BY THE PRESIDENT.

FIRST PRINCIPLES

RECENTLY DR. GEORGE A. KEYWORTH, SCIENCE ADVISOR TO THE PRESIDENT, APPEARED BEFORE SEVERAL COMMITTEES OF THE CONGRESS TO PRESENT THE ADMINISTRATION'S VIEWS ON THE THE FEDERAL R&D BUDGET FOR FY 1986. WE SHOULD LIKE TO BEGIN THIS STATEMENT BY BRIEFLY RESTATING THE SUBSTANCE OF SEVERAL FAMILIAR THEMES TAKEN FROM DR. KEYWORTH'S REMARKS. WE HAVE ADDRESSED THESE POINTS IN EARLIER TESTIMONY BEFORE THIS COMMITTEE. THE RESEARCH ENTERPRISE WILL BE WELL SERVED IF THESE PRINCIPLES INFORM OUR RESPONSE TO PRESENT CIRCUMSTANCES AND GUIDE OUR LONGER RANGE R&D PLANNING AND BUDGETING. AMONG THE POINTS DR. KEYWORTH EMPHASIZED WERE THESE:

1. OUR SCIENTIFIC LEADERSHIP IS EXTREMELY FRAGILE. IT REQUIRES CONTINUOUS AND CAREFUL ATTENTION. SHORT-TERM BUDGET CONSTRAINTS ON OUR RESEARCH ENTERPRISE ARE ACCEPTABLE, BUT ONLY IF WE RECOGNIZE THAT THE LONGER TERM HEALTH OF OUR PEOPLE, OUR ECONOMY AND OUR NATIONAL SECURITY REQUIRE A CONTINUOUS COMMITMENT TO INVEST IN THE NECESSARY EFFORT TO SUSTAIN OUR LEADERSHIP.

2. TECHNOLOGY AND TALENT ARE OUR TWO COMPETITIVE ADVANTAGES; NATIONAL INVESTMENT IN THEM MUST BE SUSTAINED. EXPLOITATION OF TECHNOLOGY, MAINTENANCE OF ECONOMIC HEALTH AND NATIONAL SECURITY REQUIRE PREEMINENCE IN BASIC SCIENCE AND A SUSTAINED COMMITMENT TO EXCELLENCE IN THE TRAINING OF YOUNG PEOPLE.

3. CONSTRUCTION, MODERNIZATION AND RETOOLING OF OUR RESEARCH FACILITIES MUST RECEIVE PRIORITY ATTENTION IN OUR R&D PLANNING AND BUDGETING IN THE YEARS IMMEDIATELY AHEAD. THE MISSION AGENCIES SHOULD BEGIN NOW TO RE-EXAMINE AND TO IMPROVE THEIR CAPACITIES TO SUPPORT, DEVELOP, AND MANAGE QUALITY BASIC SCIENCE AND ENGINEERING PROGRAMS IN FIELDS APPROPRIATE TO THEIR MISSIONS.

4. MISALLOCATIONS OF OUR LIMITED RESOURCES WILL COMPROMISE OUR COMMITMENTS TO QUALITY AND EXCELLENCE IN OUR GRADUATE EDUCATION AND RESEARCH PROGRAMS, AND THEY WILL PLACE OUR SCIENTIFIC AND TECHNICAL LEADERSHIP AT RISK.

WITH THESE ORGANIZING PRINCIPLES IN MIND WE OFFER THE FOLLOWING OBSERVATIONS ON THE FY 1986 BUDGET REQUEST OF THE NATIONAL SCIENCE FOUNDATION, AND ON THE CONSEQUENCES OF PENDING ACTION TO FREEZE THE FOUNDATION AT FY 1985 LEVELS.

THE FY 1986 BUDGET REQUEST

FIRST, IN THIS MOST UNUSUAL BUDGET YEAR, THE NSF BUDGET REQUEST, WHILE NEITHER AS BOLD NOR AS AMBITIOUS AS SOME PREVIOUS REQUESTS, IS GENERALLY A WELL-BALANCED, CAREFULLY CRAFTED, AND SATISFACTORY ONE FOR UNIVERSITY RESEARCH AND GRADUATE PROGRAMS. IT DESERVES THE SUPPORT OF THE RESEARCH COMMUNITY AND THE ACTIVE SUPPORT OF THE CONGRESS.

THE BUDGET REQUEST RETAINS A REASONABLE AND APPROPRIATE BALANCE AMONG THE FOUNDATION'S CORE RESEARCH PROGRAMS. IT PURSUES PRIORITY INITIATIVES, INCLUDING THE INTERDISCIPLINARY ENGINEERING CENTERS, THE PROGRAM TO IMPROVE ACCESS TO SUPERCOMPUTERS, THE CONTINUING EFFORT TO UPGRADE RESEARCH INSTRUMENTATION AND RESEARCH RELATED TO BIOTECHNOLOGY. REASONABLE INCREASES TO MEET THE COSTS OF INFLATION AND PROVIDE FOR A SMALL MARGIN OF GROWTH ARE PROPOSED FOR MOST MAJOR RESEARCH PROGRAMS. WE ARE ESPECIALLY

PLEASED TO SEE THE SPECIAL COMMITMENT TO RESEARCH IN THE MATHEMATICAL SCIENCES. THE CASE FOR RESEARCH IN THE MATHEMATICAL SCIENCES IS MADE COMPELLINGLY BY THE RECENT NATIONAL ACADEMY OF SCIENCES REPORT, RENEWING U.S. MATHEMATICS. WE DO NOTE WITH CONCERN, HOWEVER, THAT THE SELECTED INCREASES ARE ACCOMPLISHED IN PART THROUGH THE TERMINATION OF SEVERAL VALUABLE SMALLER PROGRAMS, INCLUDING THE UNIQUE ETHICS AND VALUES IN SCIENCE AND TECHNOLOGY PROGRAM.

THE MAJOR INITIATIVES IN ADVANCED COMPUTING AND ENGINEERING MUST GO FORWARD. WE URGE NSF, THIS COMMITTEE AND THE CONGRESS TO ENSURE THAT EACH CENTER RECEIVES ADEQUATE SUPPORT TO FUNCTION PROPERLY AND TO FULFILL ITS MISSION. THE BROADER RESEARCH COMMUNITY WILL BE ILL-SERVED BY A RAPID PROLIFERATION OF INADEQUATELY FUNDED SUPERCOMPUTER AND ENGINEERING CENTERS. NEW CENTERS SHOULD NOT PURCHASED AT THE COST OF IMPOSING INEFFICIENT OPERATION ON OTHERS. HERE, TOO, THE PRINCIPLE OF QUALITY RATHER THAN QUANTITY OUGHT TO BE THE GUIDE IN ESTABLISHING THESE IMPORTANT AND COSTLY ACTIVITIES.

CLOSELY RELATED TO THIS CONCERN IS THE NEED TO RETAIN A PROPER BALANCE IN FUNDING BETWEEN THE MAJOR NEW INITIATIVES AND FUNDING FOR COMPETITIVE AWARDS TO INDIVIDUAL RESEARCHERS THAT ARE THE BACKBONE OF NSF RESEARCH PROGRAMS. RECENT PROGRESS IN STRENGTHENING THE SIZE AND DURATION OF THE AVERAGE NSF GRANT SHOULD NOT BE ERODED BY THE NEW PROGRAMS. AGAIN, THE STRATEGY OUGHT TO ADHERE TO THE PRINCIPLES OF QUALITY AND STABILITY IN ONGOING RESEARCH AND TRAINING ACTIVITIES.

THE NEW ENGINEERING RESEARCH CENTERS, THE PROGRAM TO PROVIDE ACCESS TO ADVANCED SCIENTIFIC COMPUTING, THE PROPOSED CONTINUED INVESTMENT IN RESEARCH INSTRUMENTATION, AND THE PROGRAMS TO STRENGTHEN OUR INVESTMENT IN PEOPLE; I.E., THE PRESIDENTIAL YOUNG INVESTIGATORS PROGRAM, POSTDOCTORAL, AND GRADUATE FELLOWSHIP PROGRAMS, ARE ESSENTIAL INVESTMENTS IN OUR SCIENTIFIC AND TECHNOLOGICAL FUTURE. THEY DESERVE THE SUPPORT OF THE RESEARCH

COMMUNITY AND THE CONGRESS. THE ACTIVITIES DESIGNED TO ENHANCE THE RESEARCH CAREER PROSPECTS FOR OUR MOST TALENTED YOUNG MINDS, ESPECIALLY WOMEN AND MINORITIES, MUST CONTINUE TO RECEIVE PRIORITY ATTENTION. PRESENT BUDGETARY CONCERNS SHOULD NOT BE ALLOWED TO WEAKEN OUR COMMITMENT TO ATTRACTING THE VERY BEST TALENT INTO RESEARCH AND TEACHING CAREERS. WE ARE PLEASED TO NOTE THAT THE BUDGET REQUEST ATTEMPTS TO PROTECT RECENT GAINS IN THIS AREA.

SOME MAY ARGUE THAT THE NSF BUDGET REQUEST IS DEFICIENT. IN RESPONSE WE RESPECTFULLY SUGGEST, HOWEVER, THAT NOW IS NOT THE TIME TO SECOND GUESS THE UNDERLYING SCIENTIFIC AND TECHNICAL JUDGMENTS REFLECTED IN THE FOUNDATION'S BUDGET REQUEST. TO DO SO WILL IGNORE THE OBVIOUS AND CAREFUL BALANCING OF PRIORITIES REFLECTED IN THE REQUEST. IF ATTEMPTS ARE MADE TO RESPOND TO SPECIAL PLEAS TO REALLOCATE SIGNIFICANT AMOUNTS OF FUNDS FROM CERTAIN RESEARCH PROGRAMS TO OTHERS, OR FROM RESEARCH ACTIVITIES TO OTHER FUNCTIONS, THE FUNDAMENTAL PRINCIPLES OUTLINED ABOVE QUICKLY WILL BE VIOLATED TO THE DETRIMENT OF THE ENTERPRISE OVERALL. THIS BUDGET IS A RESTRAINED AND RESPONSIBLE REQUEST. IT IS NEITHER SERIOUSLY OUT OF BALANCE NOR SO DEFICIENT AS TO JUSTIFY A REALLOCATION OF FUNDS AMONG THE MAJOR RESEARCH PROGRAMS OR FROM THEM TO OTHER PURPOSES. IF SUCH PROPOSALS ARE MADE WE ASK THAT THE COMMITTEE REJECT THEM, AND IF NECESSARY, ASK YOUR SENATE COLLEAGUES ALSO TO REJECT THEM.

THE BUDGET REQUEST FOR THE DIVISION OF SOCIAL AND BEHAVIORAL SCIENCE MERITS A SPECIAL WORD. THE BUDGET FOR THESE PROGRAMS REFLECTS A CONTINUING COMMITMENT TO RESTORE THEM TO A MORE APPROPRIATE POSITION AMID THE FOUNDATION'S PROGRAMS. THE INCREASES FOR THE DIVISIONS OF SOCIAL AND ECONOMIC SCIENCE AND BEHAVIORAL AND NEURAL SCIENCE REFLECT A RECOGNITION OF THE INTELLECTUAL VITALITY AND IMPORTANCE OF THESE FIELDS. FOR MOST OF THESE DISCIPLINES THE FOUNDATION IS THE MAJOR OR SOLE SOURCE OF FEDERAL INVESTMENT. DESPITE THE REQUESTED INCREASES, ONE MUST NOTE, THESE PROGRAMS ARE NOT YET IN REAL TERMS BACK TO THEIR 1980

FUNDING LEVELS. WE THANK THE COMMITTEE FOR YOUR PREVIOUS SUPPORT OF THESE AREAS, AND WE URGE THAT THEY BE SUPPORTED AT THE LEVELS REQUESTED.

SCIENCE AND ENGINEERING EDUCATION

NEXT, WE SHOULD LIKE TO BRIEFLY ADDRESS THE FOUNDATION'S PROGRAM IN SCIENCE AND ENGINEERING EDUCATION. WE SUPPORT FUNDING THE FOUNDATION'S SCIENCE AND ENGINEERING PROGRAMS AT CURRENT YEAR LEVELS.

FOR THE PAST SEVERAL YEARS WE HAVE JOINED WITH MANY OTHERS IN SUPPORTING THE DEVELOPMENT OF SOUND SCIENCE AND ENGINEERING EDUCATION PROGRAMS IN THE FOUNDATION. WE CONTINUE TO SUPPORT AN NSF LEADERSHIP ROLE IN DESIGNING ACTIVITIES TO STRENGTHEN PRECOLLEGE AND UNDERGRADUATE SCIENCE AND ENGINEERING PROGRAMS. NSF MUST RETURN TO A POSITION OF NATIONAL LEADERSHIP IN THIS AREA. WE SHARE A SENSE OF IMPATIENCE THAT MORE CANNOT BE DONE MORE QUICKLY, BUT WE ALSO RECOGNIZE THE MANAGEMENT DIFFICULTIES ASSOCIATED WITH SO AMBITIOUS AN UNDERTAKING AS THE PRESENT ONE. THEREFORE WE BELIEVE IT WOULD BE A MISTAKE TO ACCELERATE FUNDING BEYOND THE LEVEL PROPOSED UNTIL THE PROGRAM IS FULLY PREPARED TO UTILIZE ADDITIONAL RESOURCES EFFECTIVELY.

RECENTLY DR. JAROSLAV PELIKAN, STERLING PROFESSOR OF HISTORY AT YALE, ON THE OCCASION OF THE SESQUICENTENNIAL OF TULANE UNIVERSITY, SAID THIS ABOUT THE IMPORTANCE OF UNDERGRADUATE EDUCATION TO THE UNIVERSITY:

> ". . . THE DIFFERENCE BETWEEN BAD SCHOLARSHIP AND GOOD SCHOLARSHIP IS THE RESULT OF WHAT WE DO IN THE GRADUATE SCHOOL, BUT THE DIFFERENCE BETWEEN GOOD SCHOLARSHIP AND GREAT SCHOLARSHIP IS THE RESULT OF WHAT WE DO IN THE COLLEGE."

THE BOUNDARIES BETWEEN TWO-YEAR INSTITUTIONS, FOUR-YEAR COLLEGES AND GRADUATE UNIVERSITIES ARE, IN PART, SIMPLE AND NECESSARY ADMINISTRATIVE CONVENIENCES; THEY ARE NOT IMPERMEABLE WALLS. THEY SHOULD NOT BE SEEN AS BARRIERS TO BETTER UNDERSTANDING OF THE MORE FUNDAMENTAL COMMUNITY OF INTEREST SHARED BY ALL LEVELS OF THE NATIONAL EDUCATION AND RESEARCH ENTERPRISE. AS THE NEW NSF SCIENCE AND ENGINEERING EDUCATION ACTIVITY IS DEVELOPED THE UNIVERSITIES JOIN WITH UNDERGRADUATE INSTITUTIONS TO ASK THAT THE NEEDS AND ROLE OF THE UNDERGRADUATE INSTRUCTIONAL PROGRAMS ALSO BE ADDRESSED. WE ARE PLEASED TO NOTE THAT THE FOUNDATION PROPOSES TO CONTINUE AND STRENGTHEN SOMEWHAT ITS PROGRAM OF RESEARCH AT PREDOMINATELY UNDERGRADUATE INSTITUTIONS.

GRADUATE FELLOWSHIPS

WITH REGARD TO THE GRADUATE FELLOWSHIP PROGRAM, WE NOTE THAT LEVEL FUNDING AT THE FY 1985 LEVEL IS PROPOSED. IN THE LAST TWO YEARS SIGNIFICANT PROGRESS HAS BEEN MADE TO STRENGTHEN THE PROGRAM BY INCREASING THE STIPEND ($11,100) AND COST OF EDUCATION ALLOWANCE ($6,000). HOWEVER, IT IS IMPORTANT TO UNDERSTAND THAT THE PROGRAM CONTINUES TO LAG BEHIND MARKET FORCES IN THE COMPETITION FOR NEW TALENT.

THE NEW DOD GRADUATE FELLOWSHIP PROGRAM OF THE OFFICE OF NAVAL RESEARCH (ONR) IS A MORE EFFECTIVE INCENTIVE FOR THE VERY BEST MINDS TO PURSUE GRADUATE TRAINING IN THE SCIENCES AND ENGINEERING. THE ONR PROGRAM RECOGNIZES THE CURRENT LABOR MARKET DEMAND FOR TALENTED BACHELORS LEVEL SCIENTISTS AND ENGINEERS. IT SEEKS TO COMPETE FOR THOSE INDIVIDUALS BY PROVIDING STIPENDS OF $13,000 TO $14,000, FULL TUITION PLUS A SUPPLEMENTAL RESEARCH AWARD TO THE HOST DEPARTMENT. IF THE FOUNDATION WERE TO ADOPT THIS APPROACH IT WOULD SUBSTANTIALLY STRENGTHEN ITS GRADUATE FELLOWSHIP AND MINORITY GRADUATE FELLOWSHIP PROGRAMS.

THE COST OF BRINGING THE STIPEND INTO LINE WITH THE DOD PROGRAM WOULD BE ABOUT $3 MILLION. A COMPARABLE INCREMENT WOULD INCREASE

THE COST OF EDUCATION PAYMENT TO ABOUT $8,000, A LEVEL CLOSER TO PRESENT TUITION LEVELS IN LEADING INDEPENDENT AND PUBLIC UNIVERSITIES. THESE OUGHT TO BE THE NEXT STEPS TAKEN.

RESEARCH FACILITIES

DR. KEYWORTH HAS STATED THAT "WHATEVER FISCAL SCENARIO WE FACE" WE MUST BEGIN TO PROVIDE FOR PRIORITY RESEARCH FACILITIES WITHIN OUR R&D PROGRAMS. THE MOST SERIOUS PROBLEM NOW FACING OUR RESEARCH UNIVERSITIES IS THE NEED TO MODERNIZE THEIR RESEARCH LABORATORIES, INCLUDING BOTH THE RESEARCH INSTRUMENTATION NECESSARY FOR THE CONDUCT OF MODERN RESEARCH AND ADVANCED TRAINING AND, IN A GREAT MANY CASES, THE REHABILITATION OF THE LABORATORY BUILDINGS THEMSELVES. AT THE PRESENT MOMENT, HOWEVER, NO AGENCY OF GOVERNMENT POSSESSES A DATA COLLECTION AND ANALYSIS CAPABILITY WITH WHICH TO DOCUMENT, TO ANALYZE AND TO BETTER UNDERSTAND THE NATIONAL DIMENSIONS OF THE PROBLEM OR THE CONSEQUENCES OF THE CAPITAL DEFICIT FOR THE NATION'S RESEARCH PROGRAMS. THERE ARE NO PROGRAMS IN PLACE OR APPARENTLY BEING DESIGNED TO PROVIDE FEDERAL LEADERSHIP. AS A RESULT DEBATE ON THE MERITS OF THE ISSUE FREQUENTLY IS IMPEDED BY MISPERCEPTION AND MISINFORMATION.

LATE LAST YEAR THE NSF, WORKING WITH SEVERAL OTHER LEADING AGENCIES (DOD, DOE, NIH, USDA, AND NASA) PREPARED TO CARRY OUT A FIVE-AGENCY ASSESSMENT OF THE PROBLEM; THE STUDY WAS REQUESTED OF DOD BY THE HOUSE COMMITTEE ON ARMED SERVICES. AT THE LAST MOMENT, AFTER MUCH OF THE DESIGN WORK HAD BEEN COMPLETED, NSF WAS BARRED BY OMB FROM CARRYING OUT THE SURVEY. AS A CONSEQUENCE OF THE OMB ACTION NSF HAS NOT YET MOVED AHEAD TO ESTABLISH A DATA COLLECTION AND ANALYSIS CAPABILITY ON RESEARCH FACILITIES NEEDS, SIMILAR TO THE ONE NOW IN PLACE FOR RESEARCH EQUIPMENT.

WE ARE PLEASED THAT THE HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY AND THE SENATE COMMERCE COMMITTEE HAVE INCLUDED IN THEIR AUTHORIZATION BILLS SIMILAR PROVISIONS DIRECTING THE FOUNDATION TO

DEVELOP THE NECESSARY ANALYTICAL CAPABILITY ON THE FACILITIES PROBLEM.

THE SENATE COMMERCE COMMITTEE HAS ADDED THE FOLLOWING NEW SECTION TO THE COMMITTEE'S BILL, S. 903:

"SEC.9. THE NATIONAL SCIENCE FOUNDATION SHALL DESIGN, ESTABLISH, AND MAINTAIN A DATA COLLECTIONS AND ANALYSIS CAPABILITY IN THE FOUNDATION FOR THE PURPOSE OF IDENTIFYING AND ASSESSING THE RESEARCH FACILITIES NEEDS OF UNIVERSITIES. THE FOUNDATION SHALL DOCUMENT (BY MAJOR FIELDS OF SCIENCE AND ENGINEERING) THE NEEDS OF UNIVERSITIES FOR CONSTRUCTION AND MODERNIZATION OF RESEARCH LABORATORIES, INCLUDING FIXED EQUIPMENT AND MAJOR RESEARCH EQUIPMENT. THE FOUNDATION SHALL COLLECT AND ANALYZE DATA ON UNIVERSITY EXPENDITURES FOR THE CONSTRUCTION AND MODERNIZATION OF RESEARCH FACILITIES, THE SOURCES OF FUNDS FOR SUCH EXPENDITURES, AND OTHER APPROPRIATE SUBJECTS. THE FOUNDATION, IN CONJUNCTION WITH OTHER APPROPRIATE FEDERAL AGENCIES, SHALL CONDUCT THE NECESSARY SURVEYS EVERY 2 YEARS AND REPORT THE RESULTS TO THE CONGRESS. THE FIRST REPORT SHALL BE SUBMITTED TO THE CONGRESS NO LATER THAN SEPTEMBER 1, 1986."

WE ASK THE COMMITTEE ON LABOR AND HUMAN RESOURCES TO JOIN WITH THE SENATE COMMERCE COMMITTEE AND THE HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY BY ADDING THIS PROVISION TO THE FISCAL 1986 NSF AUTHORIZATION. THE FOUNDATION SHOULD BE DIRECTED TO SUSTAIN THE EFFORT AS AN INTEGRAL PART OF ITS SCIENCE RESOURCES STUDIES PROGRAM.

LAST YEAR THE AAU AND SEVERAL OTHER HIGHER EDUCATION ASSOCIATIONS JOINED WITH OTHER ORGANIZATIONS IN CALLING FOR A REAFFIRMATION OF THE ROLE OF OPEN MERIT-BASED COMPETITION IN THE AWARD OF FEDERAL RESEARCH RESOURCES, ESPECIALLY IN THE AWARD OF EARMARKED FUNDING FOR RESEARCH FACILITIES. WE WANT TO REEMPHASIZE OUR FIRM CONVICTION THAT THE NATION RECEIVES IT GREATEST RETURN ON ITS INVESTMENT OF RESEARCH AND RESEARCH FACILITIES FUNDS WHEN THEY ARE

AWARDED ON THE BASIS OF SCIENTIFIC MERIT IN OPEN COMPETITION AMONG ALL INTERESTED AND QUALIFIED PARTIES. BECAUSE THE NSF AND THE MISSION AGENCIES LACK ORGANIZED COMPETITIVE PROGRAMS FOR FACILITIES FUNDING, WE ARE LIKELY TO SEE CONTINUED PRESSURE FOR EARMARKED FUNDING FOR A PRIVILEGED FEW. WE URGE THE COMMITTEE TO CONTINUE TO RESIST SUCH APPROACHES, AND, WHILE DOING SO, TO ASK NSF TO JOIN WITH OTHER MISSION AGENCIES TO PLAN FOR AND PROPOSE RESEARCH LABORATORY REHABILITATION INITIATIVES NEXT YEAR.

THE CONSEQUENCES FOR NSF RESEARCH PROGRAMS OF A BUDGET FREEZE

MR. CHAIRMAN, THE NATION'S RESEARCH UNIVERSITIES AND COLLEGES, OF COURSE, ARE DEEPLY CONCERNED ABOUT THE LIKELY CONSEQUENCES FOR THE FOUNDATION'S RESEARCH PROGRAMS OF FREEZING THE NSF AUTHORIZATION FOR FY 1986 AT THE FY 1985 LEVEL. AS WE UNDERSTAND IT, BASED UPON MR. BLOCH'S TESTIMONY, A FREEZE OF NSF RESEARCH PROGRAMS WILL HAVE IMMEDIATE AND SERIOUS IMPACTS ON MANY OF THE PRIORITY ACTIVITIES WE HAVE JUST ADDRESSED.

SEVERAL MAJOR NATIONAL PROGRAMS IMPORTANT TO UNIVERSITY RESEARCH AND EDUCATION WILL BE REDUCED. THESE INCLUDE THE CORNELL ELECTRON STORAGE RING, THE UNIVERSITY OF WISCONSIN SYNCHROTRON, THE VERY LONG BASELINE ARRAY AND THE NATIONAL CENTER FOR ATMOSPHERIC RESEARCH (NCAR). THE NEW INTERDISCIPLINARY ENGINEERING CENTERS AND THE ADVANCED SCIENTIFIC COMPUTING PROGRAM ALSO WILL BE CUT. THE COMBINED REDUCTIONS IN THESE AREAS ARE LIKELY TO TOTAL ABOUT $30 MILLION.

THE FOUNDATION IS MAKING SIGNIFICANT PROGRESS IN ADDRESSING THE CRITICAL NEEDS TO MODERNIZE RESEARCH INSTRUMENTATION. HOWEVER, IF A FREEZE AT FY 1985 LEVELS IS IMPOSED, FUNDING FOR NEW EQUIPMENT WILL BE CUT BY ABOUT $20 MILLION. THIS WILL SERIOUSLY SET BACK THE EQUIPMENT MODERNIZATION EFFORT.

EVEN IF ALL OF THESE REDUCTIONS ARE MADE, IN ORDER TO COMPLY WITH THE FREEZE THE FOUNDATION WILL NEED TO CUT ANOTHER $20 MILLION

FROM ITS FY 1986 REQUEST. THESE REDUCTIONS WILL COME FROM NEW RESEARCH INITIATIVES AND ENHANCEMENTS ESSENTIAL TO OUR SCIENTIFIC AND TECHNOLOGICAL FUTURE. FUNDING FOR RESEARCH IN ADVANCED MATERIALS, BIOTECHNOLOGY, ENGINEERING AND THE SOCIAL AND ECONOMIC SCIENCES WILL BE REDUCED. THE SPECIAL EFFORT TO STRENGTHEN INVESTMENT IN RESEARCH AND TRAINING IN THE MATHEMATICAL SCIENCES WILL BE CUT, IMPOSING ANOTHER SET BACK ON THIS CRUCIAL FIELD. RESEARCH OPPORTUNITIES AND CAREER PROSPECTS IN EACH OF THESE FIELDS WILL BE WEAKENED JUST AT THE MOMENT WHEN WE NEED TO ATTRACT AND ENCOURAGE TALENTED PEOPLE TO PURSUE CAREERS IN THEM. THE PROSPECTS OF FITFUL COMMITMENTS AND START AND STOP FUNDING WILL DISCOURAGE MANY OF THE MOST TALENTED INDIVIDUALS FROM ENTERING THESE AREAS.

SURELY OUR COMPETITORS IN THE INTERNATIONAL MARKETPLACE ARE WATCHING US CLOSELY. THEY NO DOUBT WILL WELCOME A DECISION TO FREEZE OUR COMMITMENTS TO SCIENTIFIC EXCELLENCE AND TECHNOLOGICAL PROGRESS.

IN CONCLUSION, WE ASK THE COMMITTEE TO AUTHORIZE THE FOUNDATION'S PROGRAMS AT THE LEVEL REQUESTED BY THE PRESIDENT, AND TO PRESS EVERY OPPORTUNITY TO ENACT AN AUTHORIZATION BILL THIS YEAR AT THE LEVEL OF THE BUDGET REQUEST.

MR. CHAIRMAN, THANK YOU FOR THE OPPORTUNITY TO SHARE THESE VIEWS WITH THE COMMITTEE.

THE NATIONAL SCIENCE FOUNDATION

Fiscal Year 1986 Budget

Committee on Labor and Human Resources
U.S. Senate

April 30, 1985

The American Society for
Engineering Education
Suite 200, Eleven Dupont Circle
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W. Edward Lear
Executive Director

THE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Fiscal Year 1986
National Science Foundation

The American Society for Engineering Education welcomes this opportunity to comment on the proposed Fiscal Year 1986 budget of the National Science Foundation. We are delighted to speak in strong support for the overall NSF proposal crafted by the Administration. The FY86 agency request represents a much-needed investment in the talent and research which comprise U.S. technology. In addition, recent attention to the engineering activities of the Foundation have produced exciting changes and we appreciate the chance to laud the direction in which those changes are leading.

ASEE's membership is drawn from over one hundred major employers of engineers, several government agencies, the national engineering societies, the more than 250 accredited engineering schools of the nation, and over 10,000 individuals, many of whom are engineering faculty and students. Our members are bound together by a deeply rooted concern for the health of the country's engineering education enterprise.

ASEE is delighted to witness a blossoming public recognition of the rich contribution which engineering makes to our lives. The fruits of engineering improve our already unmatched standard of living, strengthen our economy, enhance U.S. competitiveness abroad, and provide for a strong national security. As the world moves swiftly and surely into reliance on the gifts of high technology, engineering will play an ever more pervasive role in daily living. Personal computers used by millions, life-enhancing medical technology, new and stronger materials, and vital communications systems are only a very small sampling of the countless ways in which engineering already shapes our world and will continue to do so in the future.

These blessings will not come to us without effort. Well-trained people with imaginative ideas and the tools to realize those ideas will be needed in increasing numbers by the end of this century to maintain these highly-desirable products of our engineering enterprise. Such innovators do not materialize without hard work or without the support of those who will most benefit from their endeavors. To make the American dreams of tomorrow come true demands a commitment today to strengthening every link in the innovative chain which produces U.S. technology.

The engineering "link" of that chain is only as strong as is the active recognition of the complementary partnership of science and engineering. Too often engineering is miscast as a subset of science rather than understood to be a distinct field with over a score of fully-developed disciplines, each of which generates new knowledge. This inaccurate characterization masks the inherent synergism between the two fields. Enlightenment in one often opens the door to discoveries in the other. Together they advance the pool of knowledge available to solve human problems. If we are to make the very best use of our resources to advance U.S. technology we must promote this partnership to the fullest extent possible.

Only recently has attention been focused on the problems facing the engineering "link" of the innovation chain. Mounting pressure on the country's engineering schools to meet industry's and government's needs for well-trained, highly-talented engineers threatens to undermine our already overburdened education system and, by extension, the strength of U.S. engineering. If the nation's engineering component is weakened, the entire innovation process is weakened.

The problems faced by engineering schools are as complex and diverse as the schools, students, faculty, industry and government which compose the enterprise. Several concerns, however, seem to cut across individual difficulties to capture the attention of those who have a tangible stake in the state of engineering education.

A continuing shortage of qualified engineering faculty poses a grave threat to the ability of schools to maintain both the quality and quantity of needed engineering graduates. Latest figures from 1983 estimate a faculty vacancy rate of 8.5% -- which translates to an even bleaker 23% when one accounts for the quantity of faculty needed to restore the student-faculty ratio of the 1960's. Initial assessments of the factors exacerbating the shortage cite obsolete university facilities and equipment in laboratories, the lure of higher pay and more advanced equipment in industry, burgeoning undergraduate enrollments, the high cost of graduate education, and burdensome faculty administrative duties as disincentives for young, bright graduates to pursue academic careers. Unless these conditions are reversed, engineering schools stand to lose out on bidding for the finest minds to teach and to conduct the fundamental engineering research which sustains the schools and U.S. technology.

Following are a few facts which highlight several problems facing engineering schools:

- While student undergraduate enrollment in the past decade has doubled, the number of engineering faculty has increased by only 10 percent;
- The disparity between student and faculty growth has resulted in a 32% increase in the student-faculty ratio over the last decade;
- The number of engineering doctoral degrees awarded to U.S. citizens by U.S. universities declined dramatically over the last decade, while the number of such awards to foreign nationals by U.S. schools has risen, now accounting for about 40% of all engineering Ph.D.'s.
- In 1983, of the total 18,540 full-time Ph.D. candidates in engineering, 7,687 were foreign nationals;
- Demographics project a 17% decrease in 22-year olds by 1990. This decrease will further limit the pool of engineering students who will continue on to the Ph.D. and ultimately choose academic careers;
- Studies of equipment shortages in engineering schools carry estimates up to $2 billion to bring university labs up to industry standards;

- An Association of American Universities report to the National Science Foundation in 1980 concluded that equipment used in top-ranked universities has a median age twice that of instrumentation available in leading industrial research laboratories;

- A recent study by the National Science Foundation found that 43 major research universities classified their equipment as 25% obsolete and only 16% state-of-the-art;

- In reponse to the need for interdisciplinary engineering research support, a new program for Engineering Research Centers was initiated by NSF in FY85. Half of the country's engineering schools submitted proposals, but a $10 million funding ceiling limited awards to only six schools.

Clearly our engineering schools are in trouble. Unless swift and decisive action is taken to relieve these problems, the field of engineering and the future of the nation's technological achievements will be sorely diminished.

Industry is beginning to recognize the need to help engineering schools. It sees that the problems faced by the schools will lead inevitably to poorly-prepared graduates unable to contribute to industry's needs. Cooperative arrangements which are mutually beneficial to companies and to universities can be expected to flourish in the future as both communities appreciate fully the importance of a unified effort.

ASEE has underway a project which exemplifies this growing cooperation between industry and the university community. Launched in the fall of 1984 with the support of 26 major corporations, the Quality of Engineering Education Project (QEEP) is bringing together over forty industrial and academic minds to tackle four areas critical to the health of engineering education. Task forces of eight to ten corporate and university members each have been charged with addressing one of the following factors: the state of undergraduate laboratories, preparation for the teaching of engineering, continuing professional development for engineers and engineering faculty, and the use of educational technology. As each task force defines, examines and debates its topic over the next eighteen months, bridges between industry and schools will be forged and reinforced by lively exchanges of perspective and expertise. The end result in the summer of 1986, we hope, will be a deeper understanding of the needs of both industry and academe and a plan of joint action to satisfy those needs.

For the federal government, too, there is an important and an appropriate role in strengthening the nation's engineering education system. For example, the NSF plays a vital part in supporting through fellowships the graduate students who will become tomorrow's young faculty. Research grants also sustain faculty and contribute to equipment and facilities needs. These are integral to the health of our schools and should be continued and strengthened where possible.

One major area of weakness, however, has not been fully addressed by either industry or government -- the support of fundamental engineering research. Support of such research is weak and inconsistent, to a large extent due to misperceptions about the nature of the research. Because it is substantially generic in nature -- without specific application or a goal of product development -- industries seldom can commit themselves to the long-term support of fundamental engineering research. However, the discoveries revealed through the research underpin the entire engineering enterprise by introducing new processes and systems which may spark specific innovations.

Government, too, has been hesitant in its support of fundamental engineering research, perceiving it to be commercialization-oriented, and thus appropriately the responsibility of the private sector. Increased understanding of the generic and long-term goals of fundamental engineering research, however, is beginning to filter through the government support network.

These misperceptions by both industry and government have been unfortunately detrimental to developing to its fullest potential the engineering "knowledge base" upon which technology rests. Underinvestment in this research also affects a particularly important component of the engineering education enterprise -- students. Through research support in the schools students learn to work with the equipment, processes, and innovative ideas which they will later try to develop into products in industry. Without educated people -- talent -- U.S. technology will come to a standstill.

The academic engineering community has been heartened by the recent activity at the National Science Foundation. Increased recognition of the role of engineering at NSF bodes well for making the most of the valuable partnership of science and engineering.

Specifically, we are delighted to see that the budget request for the National Science Foundation for Fiscal Year 1986 includes language which will enhance the Foundation's ability to support engineering. As you know, the NSF currently supports engineering without the benefit of a specific mandate to do so. Last year, ASEE spoke as part of the national Engineering Education Task Force, together with the National Society of Professional Engineers (NSPE) and the National Association of State Universities and Land Grant Colleges (NASULGC), in strong support of language to provide the Foundation with specific authority to lend its expertise to engineering. I believe that this language is a very important step in providing the stable and secure home for engineering on the federal level which will promote the best use of our national engineering resources.

Secondly, the reorganization of the Engineering Directorate has great potential for allowing NSF to be responsive to both the emerging and traditional needs of fundamental engineering research. Although time is needed to maximize the new arrangements, the changes should ultimately enhance our ability to compete globally in critical technologies, to meet our high goals of quality and productivity, and to provide an environment which may foster much innovation.

Thirdly, the strengthening of the Engineering Directorate's budget continues to be extremely important. After years of benign neglect, the newly developing engineering component of the NSF needs to grow. While we recognize the imperative to reduce our federal deficit, and also wish in no way to advance engineering at the expense of science, we nonetheless strongly believe that the growth curve of the Engineering Directorate must continue its positive trend if we are to achieve our most fundamental goals. Engineering still garners only approximately 10% of the Foundation's budget despite recent improvements in funding in the Engineering Directorate.

The National Science Foundation clearly is in an excellent position to address some of the problems sketched above on behalf of one important stakeholder in the health of U.S. engineering -- the federal government. While no one program or agency can hope to fulfill every need, the attention which NSF is able to give to instrumentation, to vitally-needed fellowships, and to multi-disciplinary research efforts provides a conduit through which federal resources can be leveraged efficiently and with great effect. If NSF's considerable expertise in promoting the finest in the sciences in applied to the needs of engineering, we are confident that we will see palpable, if partial, solutions to the troubles which plague us.

We urge you to give your full support to the thoughtful NSF budget package placed in your hands by the Administration. In tandem with the fine helmsmanship of Director Erich Bloch, the FY86 budget request for the NSF presents an unparallelled opportunity to invest a relatively small sum of federal dollars to obtain the best in U.S. science and engineering.

Thank you.

W. Edward Lear
Executive Director
American Society for
Engineering Education

CONSORTIUM of SOCIAL SCIENCE ASSOCIATIONS
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TESTIMONY OF THE CONSORTIUM OF SOCIAL SCIENCE ASSOCIATIONS
(COSSA)

on the

FY 1986 AUTHORIZATION FOR THE NATIONAL SCIENCE FOUNDATION

Prepared for the

COMMITTEE ON LABOR AND HUMAN RESOURCES
UNITED STATES SENATE
The Honorable Orrin G. Hatch, Chairman

April 30, 1985

American Anthropological Association * American Economic Association * American Historical Association * American Political Science Association
American Psychological Association * American Sociological Association * American Statistical Association
Association of American Geographers * Association of American Law Schools * Linguistic Society of America

The Consortium of Social Science Associations (COSSA) represents more than 185,00 American scientists across the full range of the social and behavioral science disciplines, functioning as a bridge between the academic research community and the Washington community. A list of COSSA Members, Affiliates, and Contributors is attached.

COSSA would like to take this opportunity to comment on the proposed budget for the National Science Foundation (NSF) for FY 1986. We believe the budget prepared by the Foundation is, for the most part, a good one. The 4.4% increase for NSF as a whole reflects the continuing commitment of this administration to basic research. In this era of budget constraints imposed by the size of the federal deficit, it is important to maintain the nation's investment in basic research. Without this investment by the Foundation, much of the research conducted in the social and behavioral sciences would lose its source of funding and the quality of our science and inventiveness would decline. Since social science is basic to understanding our economy and to the efficient operation of the industrial sector, one offshoot of such a decline would be to endanger the U.S. economy, innovation and productivity, and our competitive position in the world market.

COSSA is pleased with the 7% increase in the Research and Related Activities function for FY 1986. We strongly urge the maintenance of that increase during the Subcommittee's deliberations. Naturally we are heartened by the significant increase proposed for the social and behavioral sciences in the FY 1986 budget. The $5.4 million or 19% increase in the Division of Social and Economic Science reflects the long uphill climb from the nadir of the 1981-83 budget reductions in this area. Although one program has been eliminated, all other programs show good to excellent progress. The increase of 6% in the Division of Behavioral and Neural Science for behavioral science programs continues the substantial increases that occurred last year. The interest of the Congress in teaching and learning research is reflected in the funding for these programs.

The increases in both these divisions indicate a recognition by NSF of the intellectual vitality and ferment in these disciplines. It is also important to point out that for most of these disciplines NSF is the major, and sometimes sole, source of support for basic research. For example, research in physical geography receives very little support elsewhere in the public or private sectors, while NSF provides 95% of federal support for basic academic research in political science, and in some disciplines 90% of federal support for social measurement and analysis. Even in economic science, if the Economic Research Service of the U.S. Department of Agriculture is excluded, NSF provides the major portion of federal funding.

Although the increases are substantial in this tight budget year, the social and behavioral sciences at NSF still remain below their FY 1980 levels in real dollars. More importantly, the proportion of the total NSF research budget going to these programs has decreased since FY 1980 and remains only 4.1 percent of that budget. (See tables attached to testimony.)

The major increase for social and behavioral science comes in the economics program. Part of that increase comes from the transfer of ongoing projects from the Regulation and Policy Analysis program which has been eliminated. The elimination of this program is not that disturbing to COSSA as long as the commitment to this research is supported in other programs at the Foundation and this is not a harbinger of future attempts to abolish whole programs. The increase in economics also stems from a recognized national need for better data collection and analysis in the areas of international trade, productivity and economic growth. Furthermore, increased support in economics will lead to greater research on microeconomic questions which often get lost in the search for answers to large macro fiscal and monetary problems.

Large increases in the Geography and the History and Philosophy of Science (HPS) programs reflect the intellectual vitality of the research in these areas. Geography is forging new ties to other sciences -- notably the earth sciences. The HPS program is a growth stock intellectually and has the distinctive role of helping to keep all the sciences self-critical. As scientific and technological growth explode around us it is important to remember past discoveries, understand how they came about, and track new ones.

Past recognition by the Congress of the importance of teaching and learning research, exemplified by increased support for this research in FY 1985, should be recognized again in FY 1986. Support for understanding how people learn and retain information should remain a high priority for basic research in the behavioral sciences. COSSA, however, believes that funding for this research is provided best within the research programs at NSF and not in the programs in the Science and Engineering Education (SE&E) Directorate at the Foundation. While it is important to understand more about science education as a process and an area of practice, techniques and methods for improving science education always need fundamental research in a deliberate manner to produce meaningful results. Only such research, for example, will illuminate cognition and motivation. For this reason we are concerned with any attempts to increase funding for SE&E at the expense of the basic research budget.

The elimination of the Ethics and Values in Science and Technology (EVIST) program has disturbed many in the social and behavioral science community. This program serves important purposes by creating a necessary visible commitment to the issue of the ethical and moral impacts of the nation's scientific and technical advances. We urge that EVIST be retained as a separate program at NSF.

COSSA strongly believes that social and behavioral science research plays a significant role in helping to understand national problems. While solutions to those problems sometimes escape us, we provide decision-makers, whose judgments are necessary to develop those solutions, the information to make those judgments. Let us cite a few examples:

On the issue of the changing rural/urban pattern of life in the United States that impact on domestic program decisions such as aid to states and localities -- demographers have noted the internal migration patterns that precipitated the change; labor and agricultural economists have focused on the impacts of those changes on the rural and urban work forces; geographers have explored the impact of these changes on business development; and sociologists have examined the impacts of the changes on community life, both rural and urban.

On the issue that is becoming increasingly prevalent in America, the aging of our population -- economists have examined the implications of investments in different age groups (e.g. educational finance viewed contrastively with Medicare and Social Security or with job retraining); social psychologists have probed the social relations across age-defined groups; sociologists, psychologists, economists and political scientists have all investigated how the aging of America will impact on the nation's social, economic and political future.

Data from NSF-sponsored data collection efforts are being used by social scientists to evaluate participation in government programs, sources of income, labor force status, political participation, voting behavior, public opinion on issues, and life-style behaviors.

With respect to the issue of the importance of higher education and its costs to the Federal government -- sociologists, economists and psychologists know a good deal about the role of higher education in social mobility and social stratification; about class and other subcultural differences in motivation and achievement; and about subjective life satisfaction as related to education, career and 'life chances.'

The issue of immigration is one of the toughest that the Congress has dealt with over the past few years. Social scientists have examined this issue as regards resettlement, cultural adjustment, linguistic and educational programs, ethnic history, job patterns and political participation.

Congress' enactment of legislation creating the U.S. Institute of Peace suggests an interest in researching methods of conflict resolution. Further support for this research would allow the bringing together in an interdisciplinary manner the social and behavioral research on the impact of competing world economies, the dynamics of large organizations, individual rivalry and cooperation, social dynamics, and anthropological and foreign-area knowledge.

Furthermore, as the nation focuses on the need for innovation and increased productivity, let us not forget the contributions of social and behavioral science to that effort. As Frank Press, President of the National Academy of Sciences, has noted, social science has provided American business the tools which the private sector often relies upon to make its decisions. Sample surveys, human factors, reinforcement theory, organization theory, and many other concepts derived from basic social and behavioral science research have been applied to the everyday world of American business.

This Subcommittee has not forgotten those contributions in the past and COSSA is grateful for its previous actions on the NSF budget for the social and behavioral sciences. This year we urge the Subcommittee to support the proposed increases in the research budget at the Foundation and to resist attempts to reduce the commitment to growth in vital basic research by enacting a "freeze" at FY 1985 budget levels.

Thank you for the opportunity for COSSA to present its views.

NATIONAL SCIENCE FOUNDATION

Funding for Selected Directorates and Programs (in million $)

	Actual FY1980	Actual FY1981	Actual FY1982	Actual FY1983	Actual FY1984	Actual FY1985	Proposed FY1986	%Change FY85-86	%Change FY80-86
Dir. for Mathematical and Physical Sciences (MPS)	227.0	256.5	272.9	299.7	355.0	396.6	429.0	+8	+89
Dir. for Astronomic/Atmospheric Earth & Ocean Sciences (AAEO)	218.1	236.3	240.0	276.2	328.6	351.7	372.2	+6	+71
Dir. for Engineering (ENG)	76.6	83.8	93.3	101.1	128.6	150.0	170.1	+13	+122
Dir. for Scientific, Tech. and International Affairs (STIA)	36.6	36.0	40.3	44.1	36.2	44.5	38.4	-14	+5
Dir. for Biological, Behavioral and Social Sciences (SES)	185.7	185.6	176.0	190.2	223.4	252.0	272.0	+8	+46
Social and Behavioral Science Programs in BBS	52.4	43.7	32.3	36.0	42.8	50.3	56.9	+13	+9
Social & Behavioral Science As Proportion of Research & Related Activities	5.9%	4.6%	3.3%	3.7%	3.8%	3.9%	4.1%		
Science & Engineering Education	77.2	64.7	20.9	16.1	57.4	82.0	82.0*	—	+6

*Includes a deferral of $31 million from the FY 1985 appropriation.

Social and Behavioral Science Research Programs in BBS (in million $):

	Actual FY1980	Actual FY1981	Actual FY1982	Actual FY1983	Actual FY1984	Actual FY1985	Proposed FY1986	%Change FY85-86	%Change FY80-86
Division of Behavioral and Neural Sciences (selected programs)									
Neuroscience									
Psychobiology	4.5	4.3	3.4	3.7	4.4	4.4	4.7	+7	+4
Cognitive Science									
Memory & Cog. Processes	2.6	2.4	2.2	2.3	2.6	4.5*	4.6	+2	+77
Social & Dev. Psychology	3.3	2.6	1.5	2.1	2.4	3.1*	3.2	+3	-3
Linguistics	2.7	2.2	2.1	2.2	2.5	3.1*	3.2	+3	+19
Anthropology	6.6	6.0	5.5	5.8	6.6	6.7*	7.3	+9	+11
Subtotal	19.7	17.5	14.7	16.1	18.5	21.8	23.0	+6	+17
Division of Social and Economic Science									
Economics & Geography									
Economics	12.2	9.4	6.3	7.1	9.4	10.2*	14.3	+40	+17
Geography	1.6	1.2	0.7	0.8	1.0	1.3*	1.6	+23	--
Social Measurement & Analysis									
Sociology	3.9	3.0	2.2	2.4	3.0	3.9*	4.2	+8	+8
Meas. Meth./Data Improve.	5.0	3.9	2.9	3.3	3.7	3.4*	3.8	+12	-24
History/Phil./Science	1.5	1.1	0.9	1.1	1.3	1.7*	2.2	+29	+47
Political & Policy Sciences									
Political Science	3.6	2.9	2.1	2.3	2.7	3.6*	4.1	+14	+14
Law & Social Sciences	0.9	0.9	1.1**	1.2	1.4	1.8*	2.2	+22	+144
Reg. & Policy Analysis	2.6	2.7	0.9	0.9	1.1	1.3*	-0-	-100	-100
Decision/Management Sci.			0.5	0.8	1.0	1.3*	1.5	+15	N/A
Subtotal	31.3	25.1	17.6	19.9	24.6	28.5	33.9	+19	+8
TOTAL-Social & Behavioral Science Research Programs	52.4	43.7	32.3	36.0	43.1	50.3	56.9	+13	+9

*Includes $5 million transfer from Science and Engineering Education for teaching and learning research (as directed by Congress)

**In FY 1981, this program was combined with the Law and Policy Program of the Division of Applied Research.

CONSORTIUM OF SOCIAL SCIENCE ASSOCIATIONS

Members

American Anthropological Association
American Economic Association
American Historical Association
American Political Science Association
American Psychological Association
American Sociological Association
American Statistical Association
Association of American Geographers
Association of American Law Schools
Linguistic Society of America

Affiliates

American Association for Public Opinion Research
American Educational Research Association
American Society of Criminology
Association for Asian Studies
Eastern Sociological Society
Economic History Association
Evaluation Network
Evaluation Research Society
History of Science Society
International Studies Association
Law and Society Association
Midwest Sociological Society
National Council on Family Relations
National Council for the Social Studies
North Central Sociological Association
Northeastern Anthropological Association
Population Association of America
Regional Science Association
Rural Sociological Society
Social Science History Association
Society for American Archaeology
Society for the History of Technology
Society for Research in Child Development
Society for the Scientific Study of Religion
Society for Social Studies of Science
Southwestern Social Science Association
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FASEB FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

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AMERICAN SOCIETY FOR CELL BIOLOGY

ROBERT W. KRAUSS
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JOHN R. RICE, C.P.A.
Comptroller

1985 MAY 16 AM 9 53

May 14, 1985

Honorable Orrin G. Hatch
Chairman
Committee on Labor & Human Resources
Dirksen Senate Office Building
Room 428
Washington DC 20510

Dear Mr. Chairman:

The Federation of American Societies for Experimental Biology wishes to express its support for the Administration's fiscal 1986 authorization request of $1,569,400,000 for the National Science Foundation (NSF), a 4.4% increase over fiscal 1985. FASEB notes that this total includes $1,397,800,000 for research and related activities, a 7% increase over fiscal 1985. Although cognizant of current budget constraints, we believe an increase in funding is justified in light of the benefits to all Americans from scientific research. For the same reason we cannot agree with the recent decision by the House of Representatives to freeze the NSF budget at 1985 authorization levels.

FASEB is a nonprofit organization whose purpose is to develop and disseminate new knowledge in the life sciences through its meetings and publications. The approximately 28,000 members of the Federated Societies represent all the important research, educational and clinical centers throughout the United States. Over the years FASEB has counted some 106 Nobel Prize winners among its membership.

In regard to the FY 86 NSF authorization request, FASEB is especially supportive of at least the proposed $9,300,000 increase in biotechnology research funding spread throughout the Biological, Behavioral and Social Sciences Directorate, the Engineering Directorate and the Mathematics and Physical Sciences Directorate. Biotechnology is rapidly becoming a key factor in the battle against disease. Biotechnology also is a new industry in which U.S. excellence gives our country an important competitive edge which we wish to maintain. The further development of this discipline requires continued adequate support from the federal government.

FASEB also supports, at a minimum, the proposed 8% increase in funding for the Biological, Behavioral, and Social Sciences Directorate (BBS) to the level of $272,100,000. Within BBS all biology programs show growth under the proposed budget. Specifically, the Cellular Biosciences program is increased by 7%, the Molecular Biosciences program is increased by 5% and the Biotic Systems and Resources program is increased by 8%. Sufficient federal investment in the basic life sciences is essential to preserve the momentum of research at a time when the scientific community is poised to take advantage of significant opportunities in a number of areas.

FASEB is deeply concerned about the April 17 action of the House of Representatives in freezing NSF spending authority at fiscal 1985 levels. Although the BBS Directorate's budget goes up about $7 million under the House action, this is less than a 3% increase over the fiscal 1985 level of $252 million. This increase does not even compensate for inflation, let alone allow any real growth in an area where growth potential abounds. We think this approach is short-sighted since basic scientific research is one of our country's great strengths.

FASEB urges your committee and the Senate to continue the long-term investment in the health and productivity of the nation by supporting an authorization of at least $1,569,400,000 for NSF in fiscal 1986, and insisting on this figure should a bill make it to conference.

Sincerely,

Robert W. Krauss
Executive Director

RWK:mls

Senator NICKLES. The hearing is now adjourned.

[Whereupon, at 11 a.m., the committee was adjourned.]

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